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McGRAW-HILL'S MAGAZINE OF OPEN SYSTEMS COMPUTING

JANUARY 1991

MARKET FORECAST
WORLDWIDE UNIX

REVIEWS
- Wyse multiprocessor mini-competitor
- Tools to write GUI software
- Affordable 4GLs compared

Update on integrated office software

Standards and UNIX security

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The NCD15b

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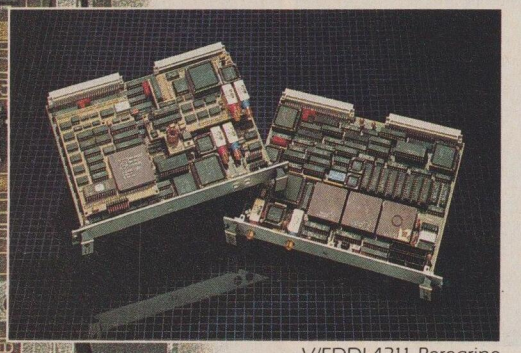
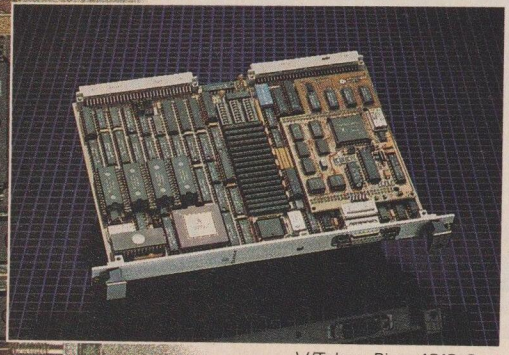
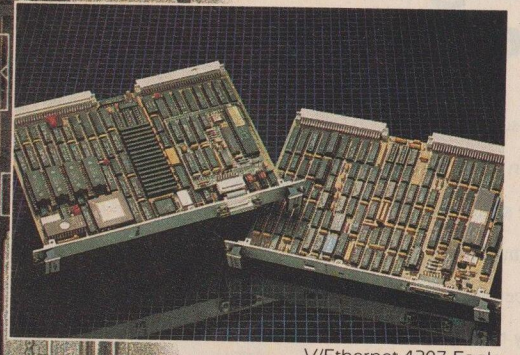


V/FDDI 4211 Peregrine
V/FDDI 3211 Falcon



V/Token-Ring 4212 Owl



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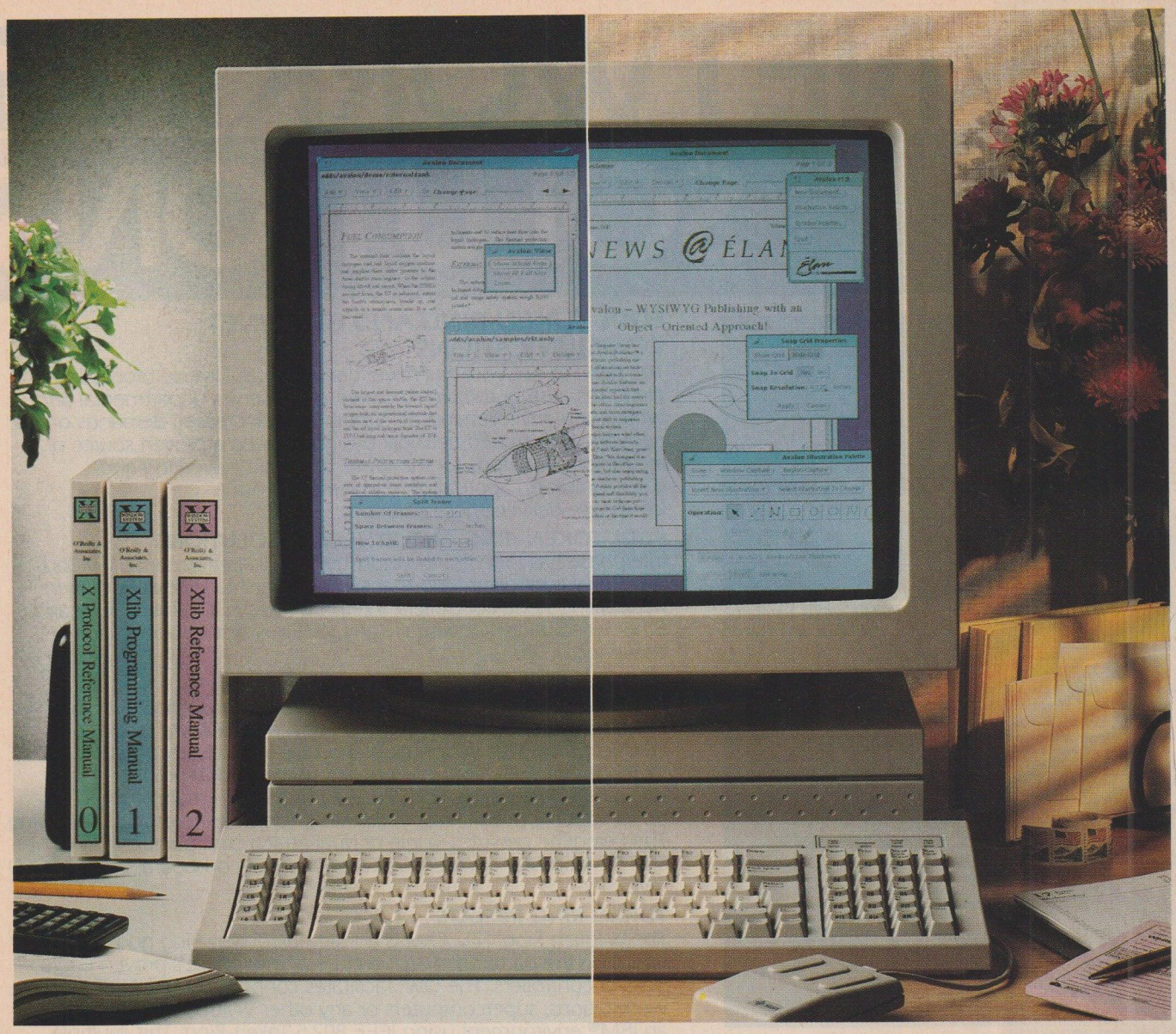

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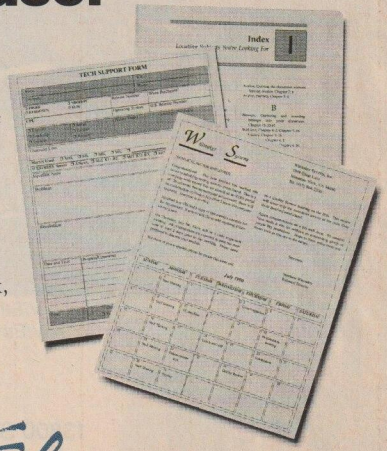

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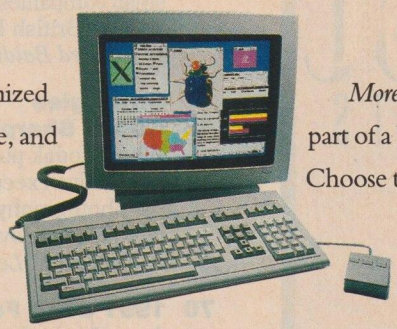

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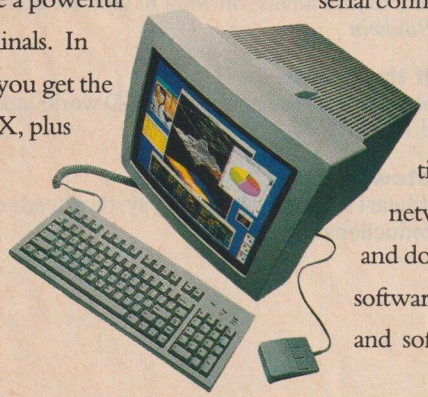

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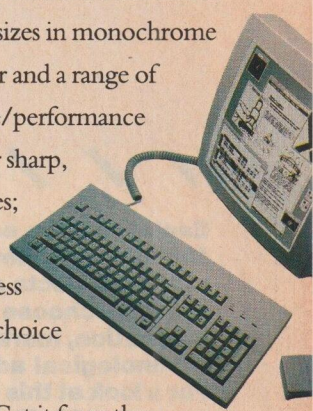

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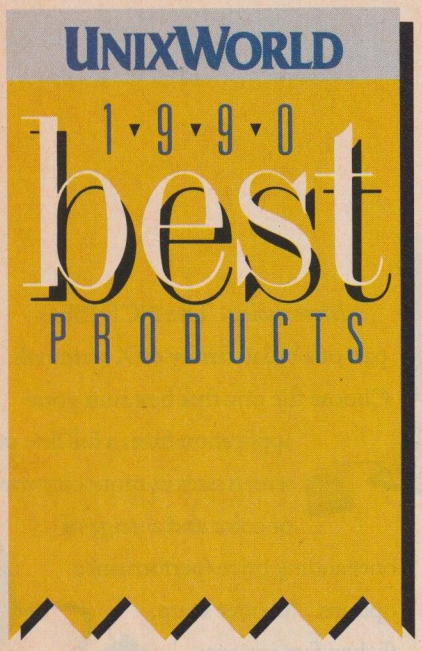

Each year, the editors of *UNIXWORLD* review the past year's products and select the best. We choose on the basis of innovation, market impact, and technological advancement. For a look at this year's winners, see page 49. (Logo illustration by Theresa Tomlin.)

FEATURES

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49 The Best Products of 1990
Long lists, many meetings, and lots of last-minute agonizing culminated with our editors' choices for the 10 best. This year's products come from a variety of sources: large corporations such as AT&T and IBM; small companies such as Legato Systems and Touch Communications; and the British IXI Ltd. Our congratulations to them all
by Howard Baldwin

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When Kodak purchased the UNIX porting house in 1988, even Interactive executives were unsure of how the company would fit into the photography giant's plans. Now Kodak is moving Interactive to a new role of providing the tools it needs to stay competitive
by Michael R. Leibowitz

70 1991 UNIX Forecast
As we begin the 1990s, we can be sure that open systems is riding a wave of acceptance that pushes it into the mainstream of the computing world. But its growth, while increasing, depends on its ability to become global
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If you manage an information system, you've probably considered moving your system to integrated functions such as word processing and e-mail. But where to begin? We interview people who already have these products to find advice on what to look for and where to find it
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Kodak's Lionheart high-speed printing system heads our hit parade of product introductions

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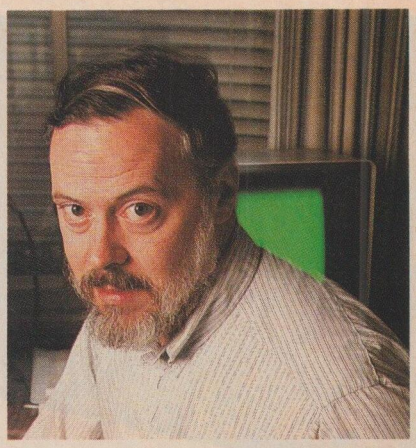

Top: *Most people know him as one of the fathers of UNIX, but who is the man behind the myth? Our Gary Andrew Poole talks with Dennis Ritchie and takes a look into the private side rarely seen.* *See page 45.*
Bottom: *Despite gloomy predictions for the computer industry, the future looks bright for UNIX and open systems. For a look at what effect worldwide events will have on the 1991 UNIX market,* *see page 70.*

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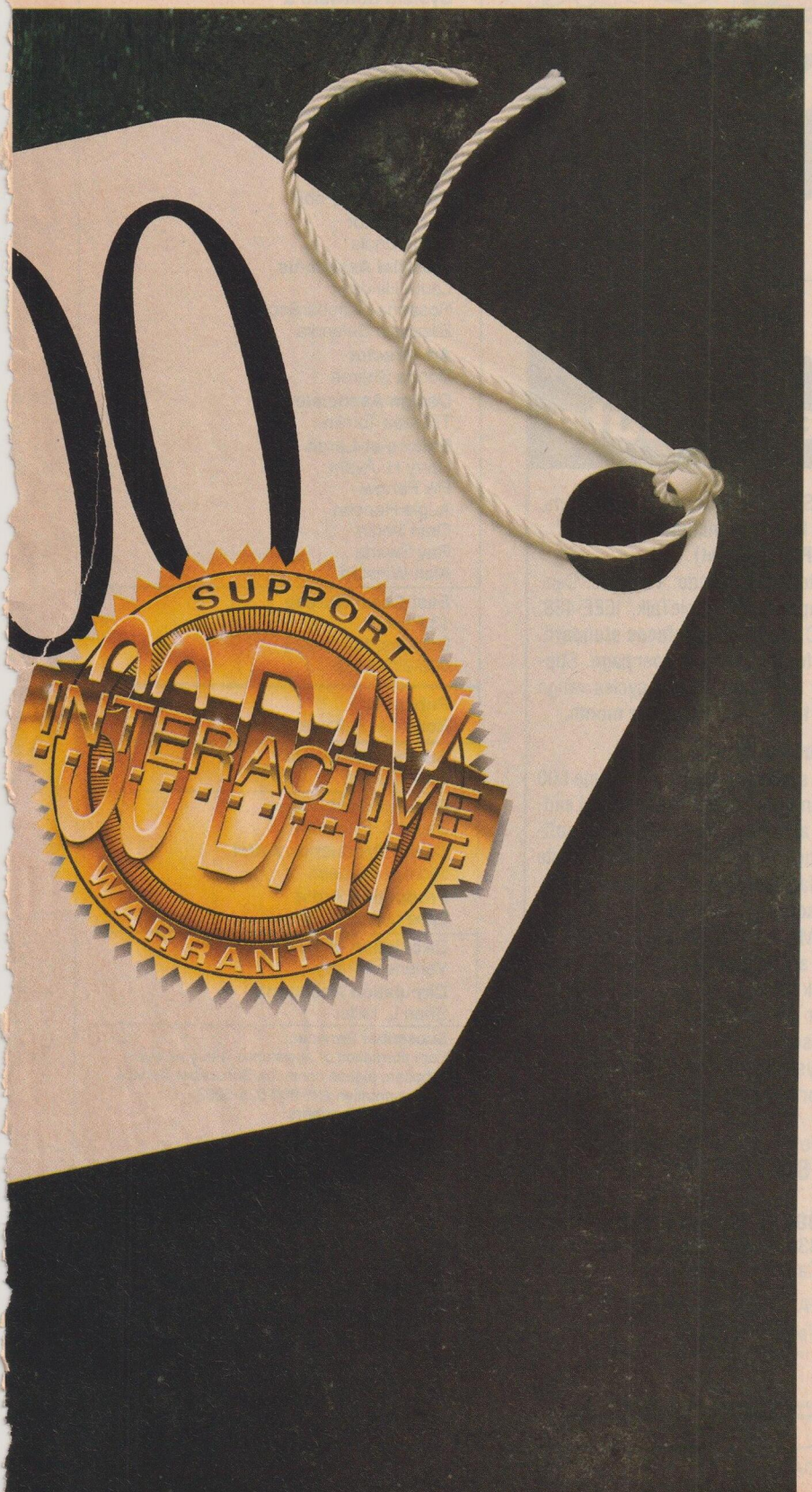

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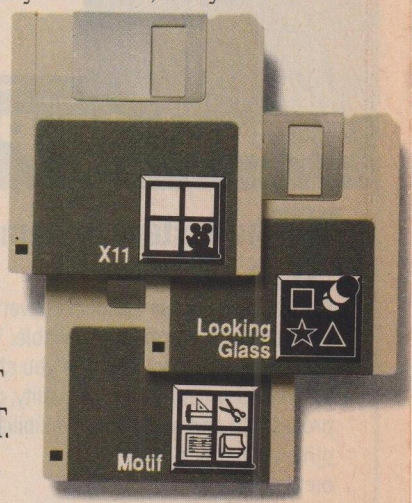

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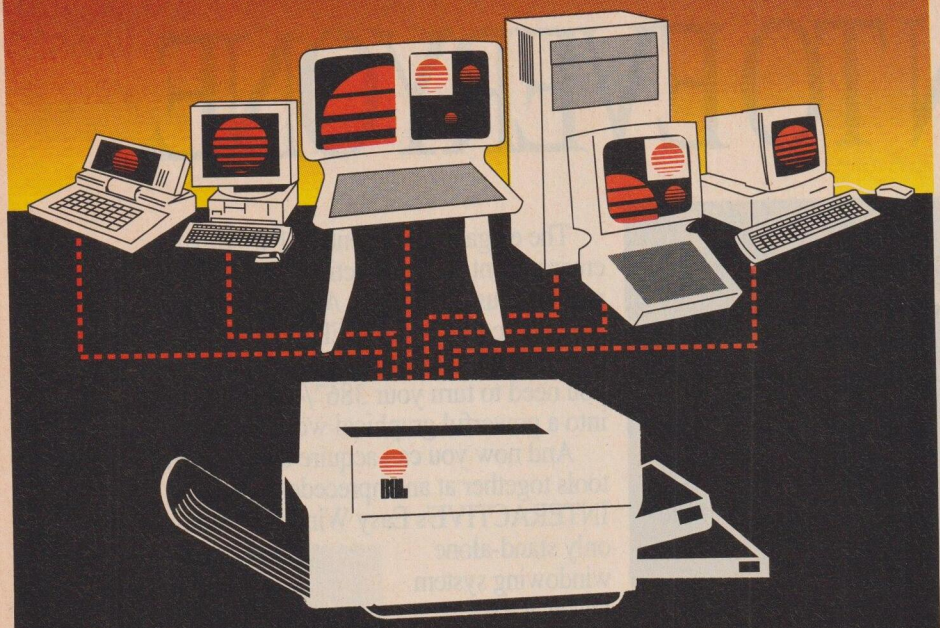

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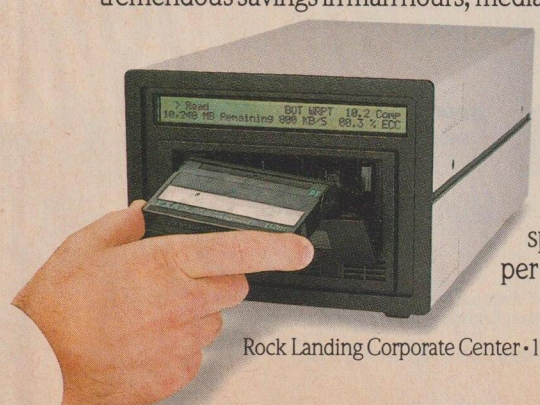

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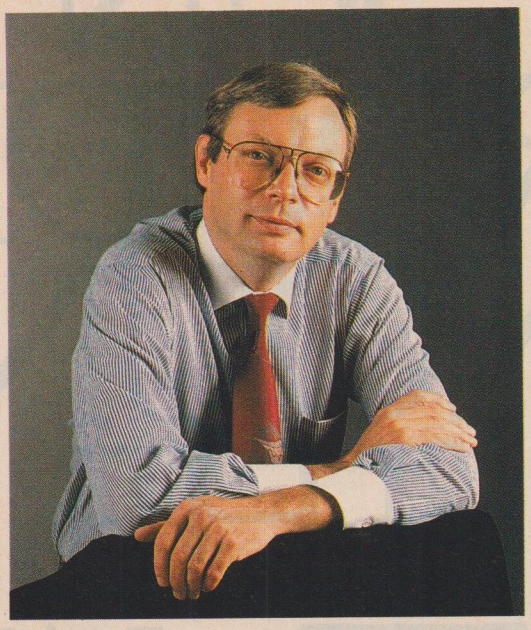


10 PREDICTIONS FOR THE '90S

I know, I know, the '90s started last year. I was busy. You don't just come up with predictions overnight, you know. You have to work up to them.

Prediction No. 1:
OS/2 will lose to UNIX on the desktop. This doesn't seem like such a long shot. In the next nine years UNIX ought to be able to get its act together, its kernel shrunk, threaded, and otherwise made acceptable to people who just can't seem to bring themselves to buy SCO's Open Desktop today. In the meantime, the OS/2 development process has been divided between IBM and Microsoft. In UNIX, when a process gets duplicated, we say it's forked. OS/2 is now forked.

Prediction No. 2:
OSF will control UNIX. I'm amazed that our AT&T 3B2 running System V.3 would let me enter this prediction. I guess this is proof that AT&T doesn't have as much control over computers running UNIX as people thought–not even their own. The fact is, AT&T's UNIX System Laboratories is in big trouble as the keeper of the UNIX Holy Grail. Once OSF replaces all of AT&T's UNIX code in OSF/2 and all the members of UI join OSF, it will be over. Sell fast, Mr. Kavner, and cut your losses.

Prediction No. 3:
50 percent of all PCs will be networked. According to IDC, 97 percent of all UNIX workstations are networked, while only 20 percent of PCs are joined in LANs. By the end of the decade most of the "You ain't puttin' no stinkin' Ethernet on my PC" crowd will be out of Corporate America, having been swept out along with the movement to downsize systems.

Prediction No. 4:
UNIX end users will start a consortium. Tired of seeing the word 'user' applied to everyone but themselves, the people who use UNIX but who aren't supposed to know it will take control. Their purpose will be to escape from their mouse-ridden GUI environments and flee to the simple beauty of the UNIX shell. Late in the '90s they will discover shell scripts.

Prediction No. 5:
An untimely demise of Sun Microsystems. Sun Microsystems will not escape financial ruin at the hands of a Far Eastern copier of Levi's jeans and Gucci watches. Despite the best efforts of U.S. Customs officials, an Asian SPARC cloner will copy the Sun Microsystems logo. The cloner's 100 mips laptop workstations will be sold out of briefcases on street corners in Manhattan, London, Tokyo, and Berlin, thus ending one of the most exciting sagas in computing.

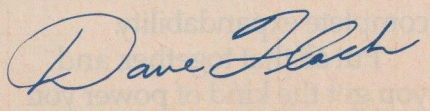
Prediction No. 6:
DEC will introduce a symmetric multiprocessing system on New Year's Eve, 1999. It will have industry-standard connectors on its serial ports.

Prediction No. 7:
SPARC and Intel will be the winners of the microprocessor wars. Microsoft will port PC/MS-DOS to Intel's i860 RISC chip "to improve graphics performance."

Prediction No. 8:
DEC will adopt SAA, paying royalties to IBM. Both will claim a victory for open systems.

Prediction No. 9:
Unix Today! will go weekly, but not daily. *Unix Review* will become more worldly.

Prediction No. 10:
Most of you will enjoy these predictions more than hearing how wonderful UNIXWORLD will be in 1991.



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POWER YOU CAN ACTUALLY USE.

To begin with, you get twice the performance. For about the same price. 28.5 MIPS. 21 SPECmarks. And 4.2 MFLOPS. You can even have up to 96MB of RAM. And as much as 7.6GB of mass storage.

But more than just a hot engine, you get everything else you need to do your job. Unbelievably real graphics. Easy networking. A huge selection of software. And complete expandability.

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THE WHOLE LINE IS AWESOME. THE PRICES AREN'T.

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And that's just the most basic color model. We've also built SPARCstation 2GS. It lets

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DEC CONTINUES OPEN SYSTEMS PUSH

In the aftermath of Digital Equipment Corp.'s philosophical turnaround from proprietary to open systems, its UNIX-based Software and Systems Division introduced two DECsystem computers, seven software applications and tools, and a price reduction of its low-end DECstation workstations at UNIX Expo in New York City in October.

At a UNIX Expo show barren of new product announcements the DEC products showed that even the most proprietary companies have accepted UNIX into their business strategies.

"There was a perception in the past that we weren't an open systems company," says Donald A. Gaubatz, workstations and servers group manager for DEC's UNIX-based Software and Systems. "We hope that doubt is gone. We have an aggressive plan."

The most significant part of DEC's "aggressive plan" includes its two RISC/Ultrix computers–the 5500 and the 5100–aimed at multiuser and server applications in banking and financial applications. The 5500 has a SPECmark rating of 21.5 and a mips rating of 28.2. The 5100 has a SPECmark rating of 14.9 and a mips rating of 19.4. Representatives from DEC touted the mips ratings as "significantly" better than other vendors' ratings.

Analysts were cautious in their praise. Paul Cubbage, an analyst with Dataquest, equates the announcements with a middle-of-the-road Cutlas automobile. Robert Kidd, also with Dataquest, says the announcements show DEC's "end-to-end commitment to UNIX." In general, Kidd was positive about the products, but he was less optimistic about how customers would react. "DEC is on a treadmill," he says. "It's hard to be on a treadmill."

CHORUS SYSTEMS AND UNISYS ANNOUNCE AGREEMENT

Chorus Systems, a Paris-based company, and Unisys Corp. have signed an agreement to develop a commercial distributed UNIX operating system based on Chorus' microkernel technology.

Chorus claims that UNIX's structure is dying. To extend its life another 10 years requires extensive modularization using a microkernel approach. A microkernel provides system servers with generic services independent of a particular operating system.

The alliance with Unisys started last year and calls for joint design work to be completed over a three-year period ending in 1992, says Hubert Zimmerman, CEO of Chorus Systems. The goal of the agreement is to develop a high-performance commercial UNIX system based on AT&T's UNIX System V Release 4. The first results from the agreement are expected in the first half of 1991.

"The rules are changing," says Jamie Riotto, director of engineering RISC platforms division at Unisys. "Users will benefit from this technology because the complexity barrier will be broken." Riotto says microkernel technology provides access-, location-, and migration-transparent communication services required for a loosely coupled, fault-tolerant, standards-compliant architecture.

Zimmerman says he plans to work with other large vendors too. Chorus is also approaching UNIX International and the Open Software Foundation, which have expressed interest in the technology. But most analysts agree that Unisys has a leg up on

the rest of the pack because it will have first rights to market systems using the new operating system technology.

NO PLANS FOR MOTOROLA TO BUY TEKTRONIX'S WORKSTATION DIVISION

Even Tektronix's new 88000-based multiprocessing server wasn't sweet enough to lure Motorola to buy the Beaverton, Ore.-based manufacturer's troubled workstation division. A Motorola spokesperson acknowledged that some thought was given to the idea initially but that she has "no knowledge of any [acquisition plans] at this time."

One explanation: Motorola's coming out with new RISC-based multiprocessing database servers of its own. Single-processor versions are slated for the first three months of 1991, with multiprocessor versions planned for sometime in the spring.

Other commitments from Motorola for 1991 include support for AT&T's System V Release 4. In other words, the operating systems for its CISC-based 68000 computers and its RISC-based 88000 computers will be compatible with SVR4. The company will also be working with Interactive Systems and Retix to integrate Streams-based TCP/IP and OSI (Open System Interconnection) protocols into Motorola's implementation of SVR4.

SUN UNVEILS AT&T SVR4 MIGRATION PLANS

While Sun Microsystems was a heavy supporter of AT&T's System V Release 4, unveiled a year ago, it has just now announced its migration plan from the Sun operating system. Sun expects only around 400 of its 2,100 software developers–about 20%–to pounce on the plan, according to Cheryl Vedoe, vice president of Sun's general systems group marketing. The platform is designed to provide a "transparent transition" for applications and is set for release in November 1991.

Releasing the test platform now, Vedoe says, allows developers to start working on SVR4-compliant applications now so that even if they have 10- to 12-month test cycles, they can plan product releases in conjunction with new releases of SVR4.

The development and test platform consists of two CD-ROMs, Sun's new distribution format for media. On one is the SunOS 4.1 development platform, which lets you create applications that will run under SunOS 4.1 now and be compatible with SVR4 later. The second CD-ROM contains the SunOS/SVR4 development platform, as well as tools to test and verify applications running under SVR4 in native mode. The tools include Open Windows Version 2, ANSI C and Fortran compilers, Sun's XGL graphics libraries, and SunNet network management license. Also included is the Binary Compatibility Package, to test and verify applications that will run under SVR4 in binary mode.

As for the other 80% of Sun developers, Vedoe anticipates they'll follow along in the next five to eight months.

UNISYS AND USL ALLY

In a move Unisys says proves its commitment to open architecture, Unisys and AT&T's UNIX System Laboratories have signed a marketing agreement. The companies will jointly market Ally, a fourth-generation language (4GL) tool from Unisys that will be fully integrated with AT&T's Tuxedo, a transaction processing system for System V.

Unisys also announced a separate software business–Ally Software Inc., a wholly owned Unisys subsidiary. "If we want to sell directly to users, we need a separate identity," says Richard C. Goyette, the newly named president of Ally. "Sun Microsystems, for example, won't want to buy a product from Unisys."

Goyette was previously the program general manager for CASE 4GL Products at Unisys. He predicts Ally, which is set up from a capital fund from Unisys, will be profitable in the first year.

continued

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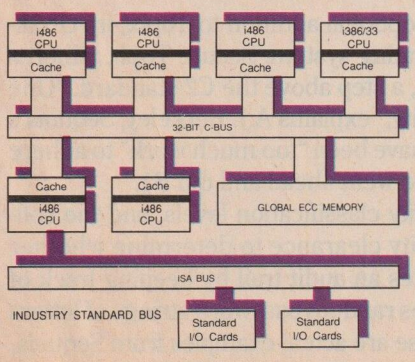
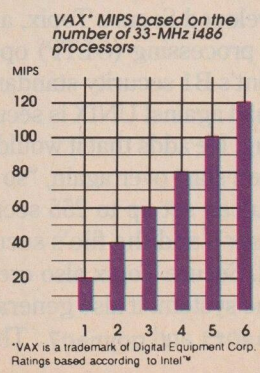


MultiAccess Series 3000 System Architecture



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CIRCLE NO. 14 ON INQUIRY CARD

Goyette says the new company has 21 sales and marketing people and 38 people in engineering. Currently, the entire staff are Unisys expatriates.

ASK-INGRES SLASHES WORKFORCE

The fallout from the Ask-Ingres merger has finally come to the fold as Ingres has cut back about 15% of its 1,200 employees. Ingres' CEO Paul E. Newton has also resigned from the company.

"Our low point was in our business strategy, not our products," says Margaret Epperheimer, director of market relations for Ingres, referring to Ingres' problems before Ask bought it. "This [the merger] is really the best thing that could happen to Ingres."

Ask bought Ingres for $131 million earlier this year. The merger was final in November.

HOW LOW CAN X TERMINALS GO?

Hot on the heels of Visual Technology's $995 X-14/ES X terminal comes Network Computing Devices' $1,495 NCD15b X terminal, at $800 less than NCD's previous low-cost machine. Company president Bill Carrico estimates that 95% of NCD's X terminals have been sold to take the place of workstations. The new low price, he believes, signals the time when X terminals finally begin to usurp ASCII terminals on the desktop.

"For the first time, because it's still a full-function X terminal," says Carrico, "it's going to attract attention at the [low] end."

Greg Blatnik, Dataquest's analyst for the terminal market, doesn't agree. "I don't believe it's a turning point," he says. "Selling [X terminals] into the workstation market is going to be a limited opportunity. For the market to really expand, many of the participants–and Dataquest–believe they have to take over more of the commercial market."

While citing the NCD15b as an "attractively priced product," Blatnik adds that the purchase of X terminals is still part of an overall system decision. "Large installations, where these will end up, can't turn on a dime," he says. Blatnik adds that although the market does seem to be accelerating he hasn't changed his forecast for widespread replacement of ASCII terminals with X terminals. He still predicts it will start about six months from now.

In any case, NCD's momentum as the X terminal leader shows no signs of abating, he says. Carrico says it has added Convex to its lengthy list of OEMs, and revealed that company sales had jumped from $14 million in 1989 to $54 million in 1990. He also anticipates the appearance in the 1990s of a portable X terminal with a flat panel monitor, but adds that the X terminal business "has to mature more before a demand shows up."

YOU CALL B1, SEQUOIA YELLS BINGO

Sequoia Systems has developed Secure Topix, an optional addition to Topix, its UNIX-based on-line transaction processing (OLTP) operating system. Secure Topix adheres to the Defense Department's B1 security standard, a step above the C2 standard. "One of the knocks OLTP has had against UNIX is security," explains A.J. Berkeley, Sequoia's vice president of marketing. He adds that it would have been "too much work" to adhere to the C2 standard and then start over again, "so we went ahead and did B1."

With Secure Topix, you can set up to 255 security classification levels, and the software will correlate the user's and the file's security clearance to determine whether access should be allowed. Secure Topix also creates an audit trail by keeping track of every attempt to access the system. It also generates random password strings of letters and numbers, such as `2jasOfi` and `goynao7`. These are actual examples from Sequoia,

which is under the impression that these can be defined as mnemonic–easy to remember.

Prices for Secure Topix begin at $30,000 and shipments start in December 1990. Sequoia also plans an April release for a database server to run Secure Topix with links to large DBMSs from Informix, Ingres, and Oracle.

RENAISSANCE FOR EPOCH SYSTEMS

Epoch Systems' new Renaissance software takes the concept of its InfiniteStorage server and extends it across the network. Epoch's InfiniteStorage server combines magnetic disks with optical disks, transferring files that are used less often onto the optical disks. That way, they're still on-line to the user's eyes.

The Renaissance software lets you apply this combination to an NFS (Network File System)-based client-server network–the software will archive files that are accessed infrequently, keeping the workstation disks less cluttered.

Greg Kenley, Epoch co-founder and chief technical officer, says Renaissance is the first implementation of the IEEE's mass storage reference model, and added that the software will be upgraded this spring to include the ability to order backups of data, both on the networked workstations and the server itself.

Renaissance software costs between $1,500 and $15,000, depending on the size of the network. Initially available on Sun workstations, the software is also being ported to Hewlett-Packard and MIPS workstations for release later this year.

SPECIALIX IS FLYING DOWN TO RIO

Multiport board manufacturer Specialix has raised the stakes in PC-based multiuser systems with a souped-up I/O system named Rio. By adding more processing intelligence to the multiport board, Specialix now lets you use an 80X86-based PC as the host for up to 128 users per slot. By installing a Rio host board in four PC slots and attaching each board to a remote terminal adapter, you can link up to 512 users to one PC.

Between the board and the remote terminal adapter, there are two different sets of chips to increase system speed on the board. Both devices use Inmos' T225 parallel processor chips (also known as its transputers), while the remote terminal adapters use two of Cirrus Logic's CD1400 communications processors. The CD1400s take the place of the UARTs (universal asynchronous receiver/transmitters) on other multiport boards.

Available interfaces are RS-232, RS-422, and parallel. Specialix Technical Director John Pettitt says, "We can keep things like the GraphOn X terminals [which use the RS-232 interface] running at 57.6K. We've also got a scalable product, because we're only using the baby of the transputer family." It's a big baby, though–32 ports will cost you $3,540, with a 128-port version priced at $12,660. Shipments begin early in 1991.

IS A STANDARDS DISASTER ON THE HORIZON?

A standards disaster is looming, according to some analysts, including William M. Bluestein of Forrester Research Inc. of Cambridge, Mass. He is the author of a report predicting a looming crisis that will hit the computer industry's standards organizations.

The bureaucracy and overlap among standards organizations permanently stunt their effectiveness, he says. As a result, users do not have the standard products they need to make their multivendor environments work.

Other analysts, including Esther Dyson, editor of *Release 1.0*, Brian Boyle of Novon Research, and Paul Cubbage of Dataquest disagree with Bluestein's assessment. The three analysts, at a panel at UNIX Expo, say the standards issue would be pushed aside as users' systems become more interoperable and the market drives vendors to comply with standards.

continued

Peter Cunningham, president of UNIX International, who was on the same panel, disagrees with the analysts' conclusions. He says the standards issue is "not going to go away anytime soon" because of the deep rift between standards-setting bodies like the Open Software Foundation and UNIX International.

INTERNATIONAL COMPUTING CHALLENGE

Over the last few months more than 450 teams of college students have been vying for a place in the finals of the Association of Computing Machinery's 15th Annual ACM Scholastic Programming Contest, which tests students' advanced programming knowledge and problem-solving techniques. The finals will be held in March in San Antonio, Tex.

The growing shortage of qualified professionals, especially programmers, has led AT&T Computer Systems to sponsor the contest, according to Curtis J. Crawford, vice president of sales, service, and support for AT&T Computer Systems. The finals is a five-hour "battle of logical and mental endurance," according to the ACM.

OVERHEARD

Selected comments from a keynote by Jim Manzi, president and CEO, Lotus Development, at UNIX Expo:

- "We don't make predictions about the future because we're on a self-imposed vaporware alert."
- "Bill Gates says UNIX has no future on the desktop. His forecast is colored a little teeny bit by self-interest."
- "With all its flavors, UNIX is still the Baskin-Robbins of operating systems."

"There's no truth to the rumor that last year's (UNIX Expo) blackout happened because of two IBM RTs trying to do floating-point calculations." —James Cannavino, president, Entry Systems Division, IBM.

"The *New York Times*' idea of multimedia is running a black-and-white photo with a story" —Andy Pollack, *New York Times* high-technology reporter, speaking at the annual conference for the Computer Professionals for Social Responsibility.

Paul Cubbage, a UNIX analyst with Dataquest, with his own "David Letterman's Top Ten Reasons DEC Is Putting Posix/UNIX on VMS":

"10. It was an accident!
9. False gods appeal to the new age religions market.
8. George Bush called them wimps for not hacking VMS.
7. They're tired of holding their breath until they turn blue.
6. No GNUs is good GNUs.
5. They want to be ready for Plan 9.
4. Since *glasnost*, Russian trucks have become more interesting.
3. The Mideast oil crisis makes snake oil an attractive alternative fuel.
2. The new New Hampshire state motto is, Live free or pay Sun royalties.
1. The number one growth market is UNIX standards organizations."

—Edited by Gary Andrew Poole with staff reports. Please send any breaking news or comments to him at: `uunet!uworld!garyp`.

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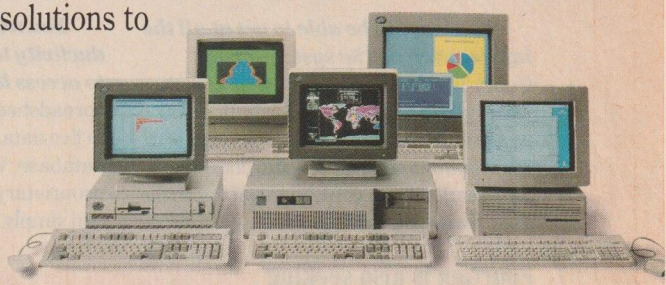

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CIRCLE NO. 139 ON INQUIRY CARD

awk DRAMA CONTINUES

Dear Editor:

I must take issue with Mr. Yap's point of view in the November Mail column, especially the sentence, "The claim that **awk** is a program that truly reflects the day-to-day workload of the typical business UNIX professional is an empty one."

I have about 30 megabytes of digital map data that needs to be translated from one format into another. **awk** is the ideal tool for this. The programs that perform the task are 120 and 30 lines of code, respectively (including comments). The data is predominantly floating point, with some string information mixed in. The processing requires both pattern matching and floating-point computations. I would estimate that the programs took about an hour to write/test and will take about one hour to run. With any luck, I will never have to convert this data again!

Much of my daily work requires ad hoc data reformatting, reduction, and analysis, and I can assure Mr. Yap that **awk** is a very efficient tool for this type of processing, especially when compared to pattern matching excercises in C or (shudder) Fortran.

Mr. Yap should be less hasty to condemn the [Neal] Nelson [benchmark] results based on his limited understanding of what others use computers for. I am grateful to Neal Nelson for including a benchmark that more realistically represents my business use of workstations than does the standard integer/floating-point performance.

Chris Hermansen
Timberline Forest Inventory Consultants
Vancouver, B.C.

Hey! Who Needs Monochrome X Terminals?

Dear Editor:

I was happy to see your October cover story on X terminal price/performance. I know many users who are making decisions about X terminals; thus, some survey of the hardware is appreciated. Unfortunately, no one with whom I deal is using monochrome X terminals, so I was dismayed to see them as the focus of your article.

Color X terminals are available from many or all of the vendors you reviewed, and have been for a year or two in most cases. Ignoring them makes the article useless to a large part of your audience, and making price/performance comparisons between color and mono X terminals is pointless. Would not it be fair to include enough color terminals that people can themselves compare?

Performance comparisons are very helpful to your readers, but please make an effort to review the current technology. Even with the publication delay built into magazine production, doing a monochrome X terminal review puts you about a year or more out-of-date.

Richard Flood
Consultant, Programmer Analyst
Doylestown, Pa.

Products Review Editor Alan Southerton replies: You are correct that color X terminals are available from many vendors. We chose to review monochrome and grayscale monitors because of their lower prices–which, after all, make an X terminal attractive when compared to a low-priced workstation or 386 platform running X terminal emulation software.

And indeed, this perspective is borne out by the fact that X vendors continue to make monochrome and grayscale X terminals.

An Exception to the Rule

Dear Editor:

Your article, "X Terminals vs. Diskless Workstations" (October 1990), by Frank Hayes, states: "The way the X protocol is implemented, there is no out-of-memory error handling–it's never handled very gracefully. The X Windows server is the program running on an X terminal. Every time you open a display on the X terminal, the X server grows."

And when there is a limited amount of memory in the X terminal, the X server could run out of memory, with unpredictable results. "In the worst case, it might bring down the computer server or the whole network," the article continues.

We at Micronics have developed an X terminal with virtual memory, the MaxTerm 19. Any program that will run on the 32-bit address space of the workstation will run on the Micronics MaxTerm X terminal. We are the only X terminal manufacturer who can make this claim. Therefore, we must take exception to the comment.

Jack Porterfield, Ph.D.
General Manager, X Terminal Division
Micronics Computers
Fremont, Calif.

Features Writer Frank Hayes replies: The comment was a quote from product manager Mark Pinone at Sun, whose company has been one of the loudest voices against the use of X terminals.

New Motif Styleguide

Dear Editor:

I was disappointed to see that Scott Raney's October article on GUI styleguides ["So You Want to Write GUI Software"] reviews an outdated version of the OSF/Motif Styleguide. We at OSF agreed that the book had deficiencies, and took the OSF/Motif 1.1 release time frame to rewrite the guide to address those problems.

We feel that this new guide (available from Prentice-Hall) not only addresses all the issues brought up by Mr. Raney, but goes even further to advance consistency among OSF/Motif applications.

Ken M. Flowers
Open Software Foundation
Cambridge, Mass.

Author Scott Raney replies: The 1.1 styleguide is a vast improvement over the 1.0 version, which is true for Motif 1.1 in general. Unfortunately, the October issue was already being printed when version 1.1 was released to Motif licensees.

An Incomplete Test for X Terminals?

Dear Editor:

During the past seven months our organization has surveyed nearly 700 sites on the topics of X, X terminals, and GUIs. One of the most consistent findings at the customer level is that a decision to use the X Window System and a graphical user interface is an organizational one, not a decision made by single users within the organization.

continued

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CIRCLE NO. 177 ON INQUIRY CARD

Two issues should be considered regarding your October 1990 cover story on X terminals. The first is the veracity of the **xbench** test as a meaningful indicator of how an X terminal will perform within any specific application. The second and more significant issue is the use of a single technical quantification of product performance as the primary product recommendation criterion.

The article calls attention to the fact that there are non-technical considerations in selecting a product. But ultimately, the product recommendation was based on a technical performance number derived from the **xbench** test suite. Any product evaluation that is biased toward a single technical quantification ignores the realities of end customers and the marketplace.

Hardware devices such as X terminals are not complete products. A complete product includes software, support and service, vendor stability, the future product family, a sales channel that can deliver, documentation, and other items that cannot be encapsulated in an Xstone rating.

Customers do not want to purchase hardware devices. They want to purchase complete products, and few of the current X terminals from any company are complete products. Some wanna-be products have hardware components that do not perform well. Others have software full of bugs. Some companies cannot support and service the blazing fast hardware devices that they sell, while others have no market history and are only in the game for short-term opportunities or to utilize factory capacity in Taiwan or Korea.

If technical benchmarks were the sole (or even primary) reason to purchase a product, PCs would probably be based on Motorola silicon, and the Intel 8086 family would be a mere footnote to the history of Silicon Valley.

Stephen Auditore
President, The X Business Group
Fremont, Calif.

Product Reviews Editor Alan Southerton replies: You make some salient points. We don't expect end users to purchase X terminals, however. We might expect that end users would like to be informed about product issues, so they could discuss them in an informed manner. As for your point about reducing the X terminal evaluations to a "single technical quantification," actually, the benchmark data comprises three separate categories of tests: software development, desktop publishing, and CAD/CAM.

UNIXWORLD welcomes letters to the editor because your opinion matters to us. If you would like to comment on past articles or just voice your opinion on an issue, either write to us at 444 Castro St., Mountain View, CA 94041, or send us e-mail at the following address: **uunet!uworld!letters**.

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CIRCLE NO. 143 ON INQUIRY CARD

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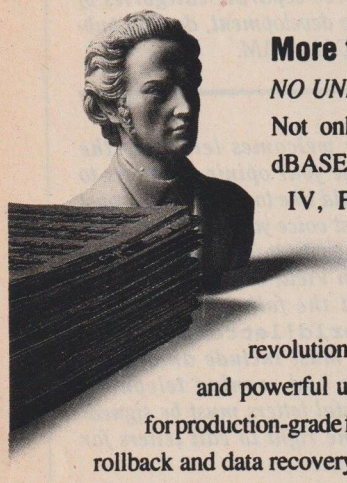

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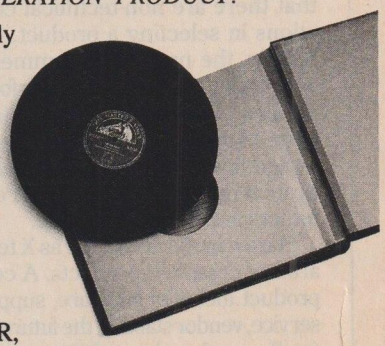

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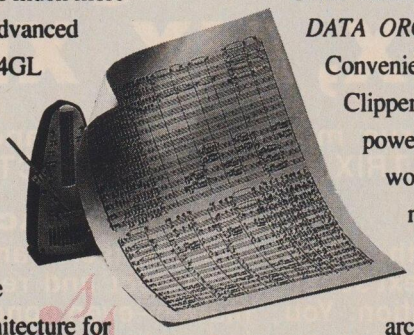

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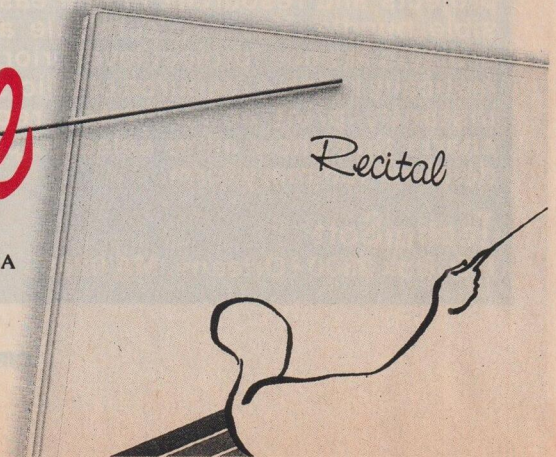


CIRCLE NO. 244 ON INQUIRY CARD

Howard Baldwin

PC SURPRISE PACKAGE FROM SILICON GRAPHICS

Big surprises of the past include the 1969 Mets winning the World Series, Laurence Olivier doing Polaroid commercials, and Cher winning a Best Actress Oscar. And now for something else completely unexpected: Silicon Graphics, one of the manufacturers most entrenched in selling expensive workstations, now sells a graphics product for the lowly personal computer.

The IrisVision two-board set for PCs brings speed for engineers, designers, and other professional illustrators to work on 3-D objects. By using the PC as a platform, SGI has brought the gamut of photorealistic rendering and imaging down to a more accessible entry level.

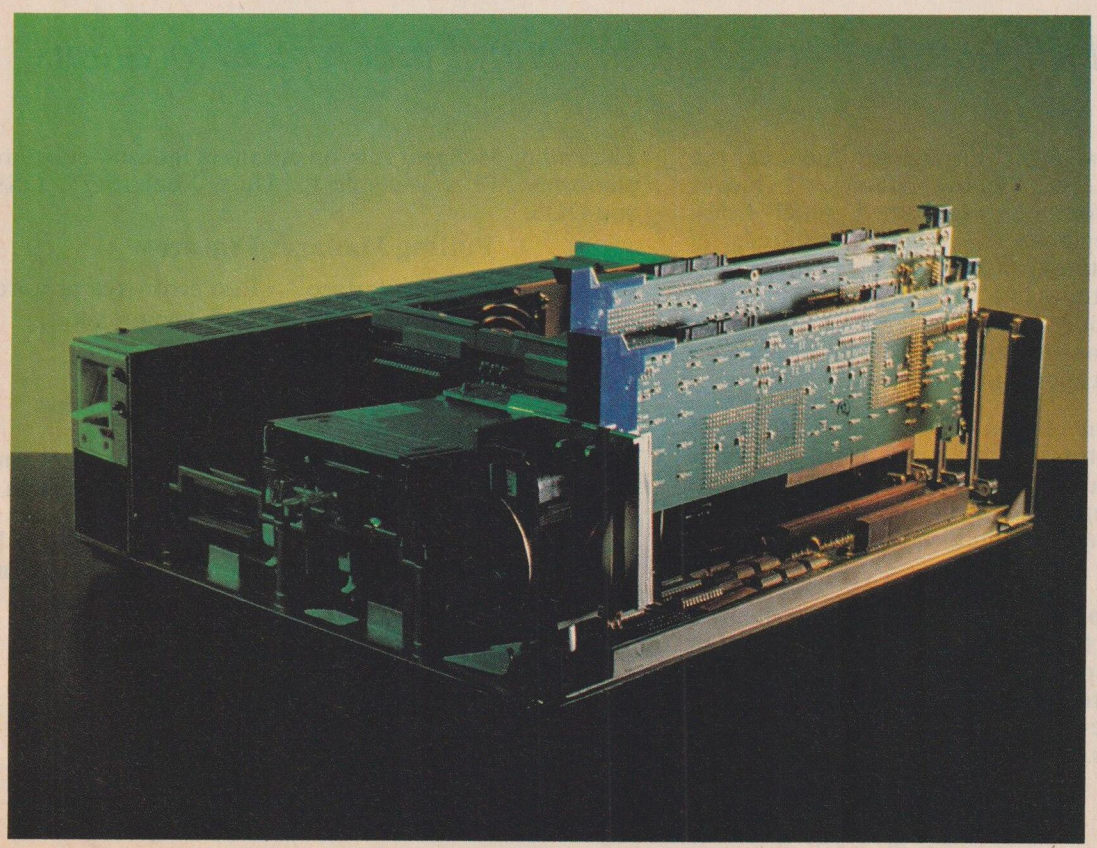
Some high-level features previously limited to workstations include a 24-bit Z-buffer as an optional upgrade (for the AT board only), as well as single or double buffering, flat or Gouraud shading, depth cueing, and anti-aliasing.

A high-resolution graphics adapter made up of two boards, IrisVision gives you 8-bit color (256 colors) on display resolutions of either 1280-by-1024 (used in three-dimensional processing) or 1024-by-768 (used in two-dimensional processing). You can get the board set for AT- and MicroChannel-based PCs, with versions for the EISA and NuBus architectures slated to appear by the end of this year. On the IrisVision boards is a proprietary 20-megaflop geometry engine, six custom VLSI (very large-scale integration) chips, and a Weitek accelerator. You can get 1.8 or 4.8 megabytes of video RAM.

The board set lets you work with The Santa Cruz Operation's Open Desktop software (also DOS and Windows 3.0). More importantly, it lets you use Silicon Graphics' Iris Graphics Library (GL) on the PC for the first time. The Iris GL is designed to let you develop high-performance visual processing applications.

Creating a PC product may seem counterproductive for a high-end workstation manufacturer like Silicon Graphics. In fact, less than half of its revenue comes from its low-end products–and the prices of its low-end products barely overlap the cost of a PC.

continued



IrisVision is a two-board set from Silicon Graphics that allows photorealistic rendering and imaging on a PC-class system. The product lets engineers, designers, and other professional illustrators work on 3-D objects without needing an expensive graphics workstation.

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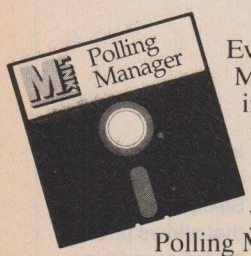

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CIRCLE NO. 103 ON INQUIRY CARD

PRODUCT OF THE MONTH

When asked why SGI should make it easier for users to do image processing on a less expensive platform, Raj Parekh, vice president of SGI's Personal Systems division, invokes an old business school chestnut. At the turn of the century, railroad companies that believed they were in the railroad business went bankrupt, while the railroad companies that insisted they were in the transportation business thrived. "We're not in the workstation business," says Parekh, "we're in the image processing business. Instead of preaching one religion over another, we're going to let the customer decide."

SGI's goal, certainly, is to establish Iris GL as a graphics standard that spans several platforms. If SGI didn't attempt to create a graphics standard for the PC, Parekh notes, somebody else would.

Shipments of IrisVision are scheduled to start in North America in January, and around the world in the spring. SGI says more than 30 software developers are

Silicon Graphics' goal is to establish Iris GL as a graphics standard for PCs and position itself in the image processing business

writing applications to use with the boards. The list includes CAD software houses like AutoDesk, CADAM, Sigma Design, and Parametrics; architecture programs from Gimeor and Dynaware; animation software from Alias, Wavefront, TDI, and Pixar; and scientific visualization software from Wolfram, the developer of Mathematica, and Polygen. Peripheral companies that plan on supporting IrisVision are Stereographics, makers of 3-D viewing devices, and Spatial Systems, makers of a hand-sized graphics control mechanism.

Suggested retail prices for the 8-bit IrisVision are $3,495 for the AT and $3,995 for the MicroChannel; for 24-bit IrisVision on the AT, the retail price is $4,995. **Silicon Graphics, 2011 N. Shoreline Blvd., Mountain View, CA 94043; 415-960-1980.**

Circle No. 301 On Inquiry Card

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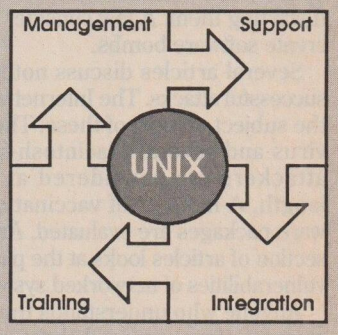

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CIRCLE NO. 188 ON INQUIRY CARD

Reviewed by Walter Zintz

THE SOFTWARE NASTIES

Leading off this month is an up-to-date survey of what to do about skulking, malevolent software. Following right behind are two independent efforts to teach a whole lot of UNIX use in just one volume.

ROGUE PROGRAMS: VIRUSES, WORMS AND TROJAN HORSES
Edited by Lance J. Hoffman
Van Nostrand Reinhold; 800-926-2665, 606-525-6600
384 pages; 8 pages of Index & Contents
ISBN 0-442-00454-0 paperbound; $32.95

Computer intrusion is the subject, but this book goes beyond saboteur software. It also looks at problems such as data theft and illicit use of computing resources. Throughout the book, the focus is split between the technical and socio/legal facets of intrusion.

The book collects 27 papers and articles. All but one are from the published literature. Hoffman's stated intent was to put together a survey of the state of the question of computer intrusion, and he's come pretty close to succeeding.

The majority of the papers are on technical points. There are numerous articles on the nature of attack software (mainly viruses) and possibilities for thwarting them. A few consider how to create software bombs.

Several articles discuss notoriously successful attacks. The Internet worm is the subject of most of these. The Brain virus and several Macintosh-specific attackers are considered at lesser length. A number of vaccination software packages are evaluated. An entire section of articles looks at the particular vulnerabilities of networked systems.

Anyone who understands the basics of computing can read these articles because they don't deal in actual code. The one exception is Ken Thompson's discussion of a virus approach that he picked up from an old Air Force security analysis. He explains via C code, but he also explains the basic C operators so that non-C programmers can follow its workings.

As a technical finale, there are three articles that deal with mathematical theories of intrusive software. These are for the compleat mathematician who is fluent in both the workings of modern math and its arcane notation.

Socio/legal discussion is briefer but broader. There are opinions surveys, done with several social groups, on their reactions to computer intrusion. Two articles look at existing codes of ethics for computer users. Ken Thompson ends his contribution with the misanthropic comment that "You can't trust code that you did not totally create yourself."

Legal aspects get equal coverage. There are overviews of what little the law has to say about computer intrusion, and how ineffective current law is at providing redress for anyone whose computer has been electronically attacked, however maliciously. Legal scholars also look at ways to extend the law's protection against intrusion, and how this might be balanced against civil liberties.

Then there are two articles not easily classified. One draws an extensive analogy between software attacks and the human immune system. The other, an analysis of potential battlefield uses of attack software in war time, gives a chilling view of what computing might be like when extortioners and terrorists turn to software tools.

Viewpoints in this book are so various that I can draw only one clear conclusion from it. With even these experts using the word "hacker" to refer to someone who causes trouble via malicious software, the word's original meaning in computing is obsolete.

This is not an "ultimate" book. I don't see a reason for so many articles on the Internet worm, a bungled job from the start, when so many clever, successful computer attacks are not covered at all. Nor can I consider the mathematical discussion complete without William Dowling's proof that it is impossible to write a program that can discover every computer virus. But this book is the best I know of now.

Review Highlights
Technical Level: Intermediate to Theorist
Understandability: Lucid to Crystal Clear
Summary: A superb managerial overview of software attacks.

UNIX SYSTEM V RELEASE 4: AN INTRODUCTION FOR NEW AND EXPERIENCED USERS
By Kenneth H. Rosen, Richard R. Rosinski, and James M. Farber
Osborne/McGraw-Hill; 415-548-2805
1,211 pages; 56 pages of Index & Contents
ISBN 0-07-881552-5 paperbound; $29.95

It begs the question: How could they put it all in one book?

System V Release 4 (SVR4) is an exhaustive combination of four widely separated UNIX variants, plus a number of independent new features from Bell Labs. This book purports to explain at least the basics of the entire kludge, plus a large collection of outside programs the authors find in frequent use on SVR4 systems. Finally, it diverges in places to compare SVR4 to MS-DOS and/or OS/2.

The result is a carnival of everything. In interactive editors, for instance, there's major coverage of **ed**, **vi**, and Emacs. Text formatting mixes an extensive look at **troff**, with frequent mentions of how **nroff** differs. PostScript, **tbl**, **eqn**, **pic**, and **grap** each get several to many pages. Previewing on bit-mapped displays, translating to the TeX formatter, and capabilities of various WYSIWYG word processors get brief mentions, too.

And yet the book generally succeeds at all this. The huge number of pages helps, of course. So does the authors' apparent decision to concentrate on the basics of each area and on changes from previous System V practice.

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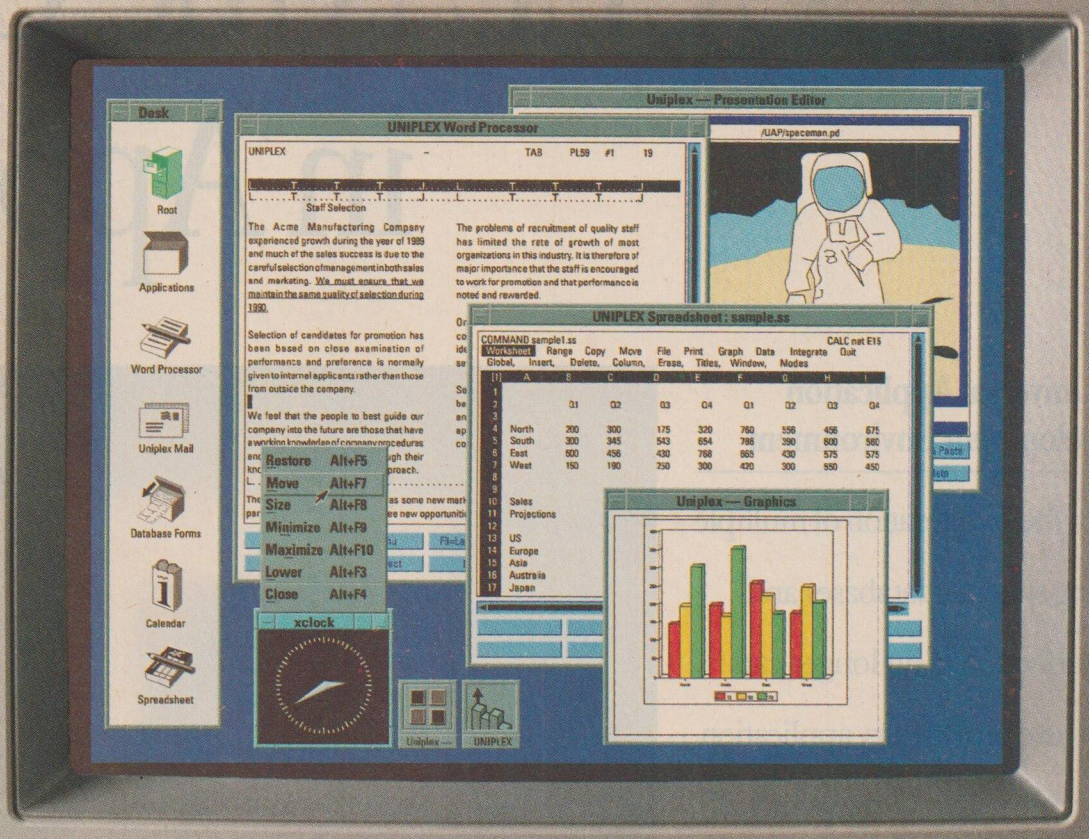

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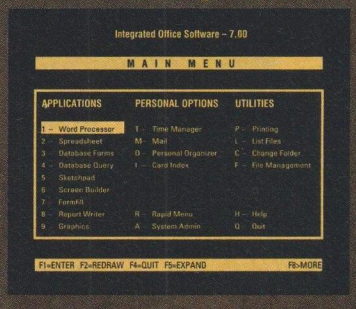

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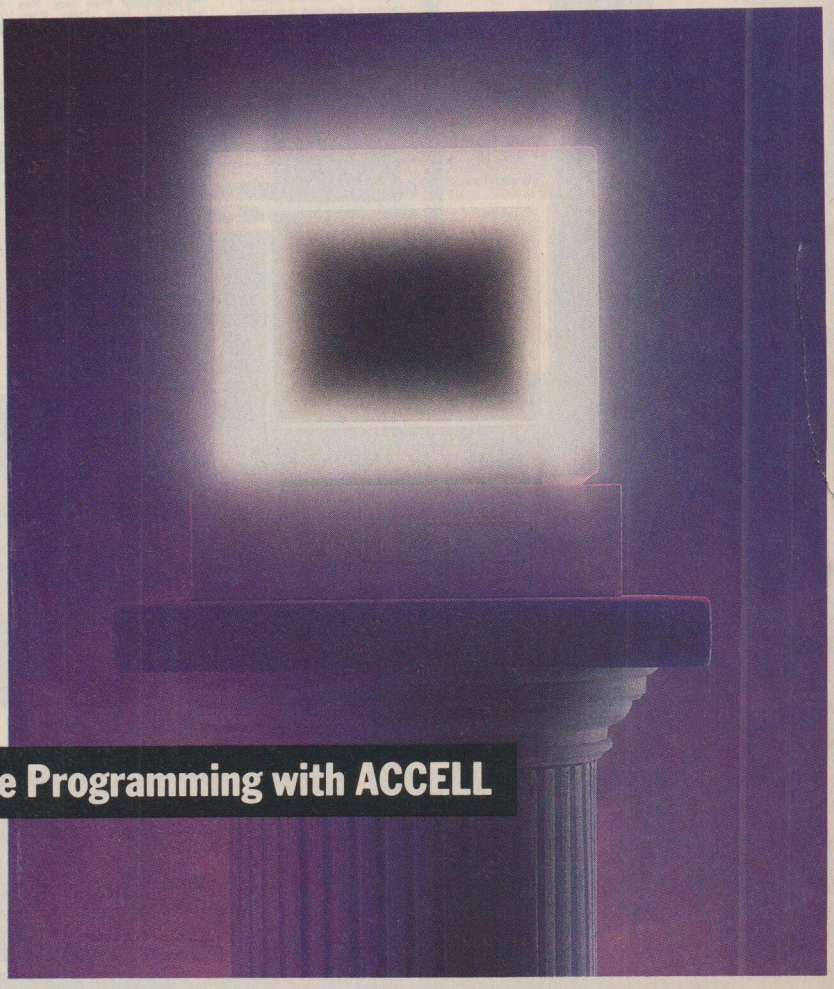

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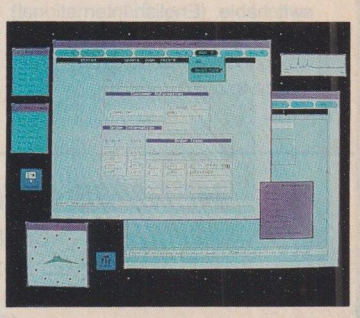

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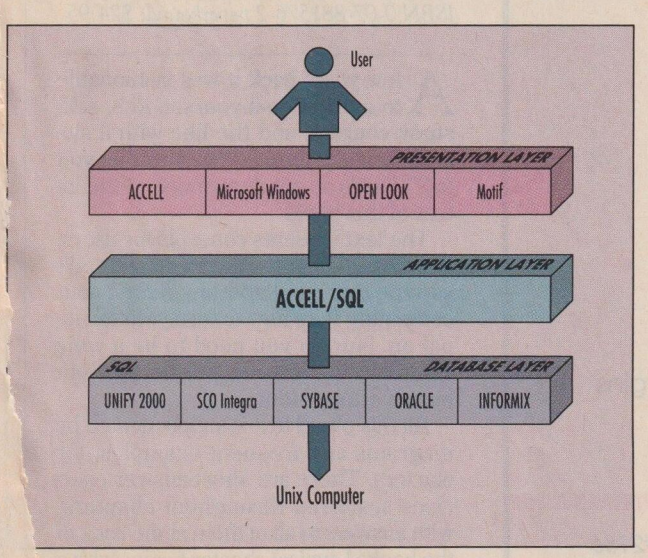

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Their big advantage, though, is an ability to cover topics clearly and simply, without wasting words. They say things lucidly, but just once. They often discuss one case and assume (correctly, I think) that the other possibilities will then be obvious to anyone who thinks about it briefly.

While the book is aimed at raw beginners new to UNIX and even to computer use, veterans of the previous System V will find it worthwhile, too. Anything that's new or changed from previous System V is mentioned as such where it comes up in the text, and flagged with a boxed warning in the margin for skimmers. Users coming from one of the other UNIX variants that were dumped into SVR4 should probably look elsewhere for quick help in making the transition.

As a bonus in case you want more, there are a lot of useful little programs included. Lest you wear out your fingers typing them in, they're available from the authors on floppies or via the net. The total cost is $19.95 to $24.95, and an order blank is part of the book's front matter.

Review Highlights
Technical Level: Beginner to Advanced
Understandability: More than Lucid
Summary: A cyclopedia of SVR4 basics, for beginners or users of earlier System V.

UNIX MADE EASY

By Lurnix
Osborne/McGraw-Hill; 415-548-2805
992 pages; 85 pages of Index & Contents
ISBN 0-07-881576-2 paperbound; $24.95

A few years back it was fashionable to market do-it-yourself kits, self-study courses, and the like with a slogan along the lines of "We won't let you fail!" That's an apt description of the intent of this book.

The text presents concepts for users, slowly and simply. These authors don't assume that you know any more about computing than how to turn your terminal on. Nor do you need to be a whiz kid, ready to latch onto fine details from just an offhand hint.

All this placid text is supplemented by diagrams and frequent examples, for starters. There are short-answer exercises scattered throughout chapters, with answers to all of them at the back of the book. A typical chapter begins with a checklist of what you need to know be-

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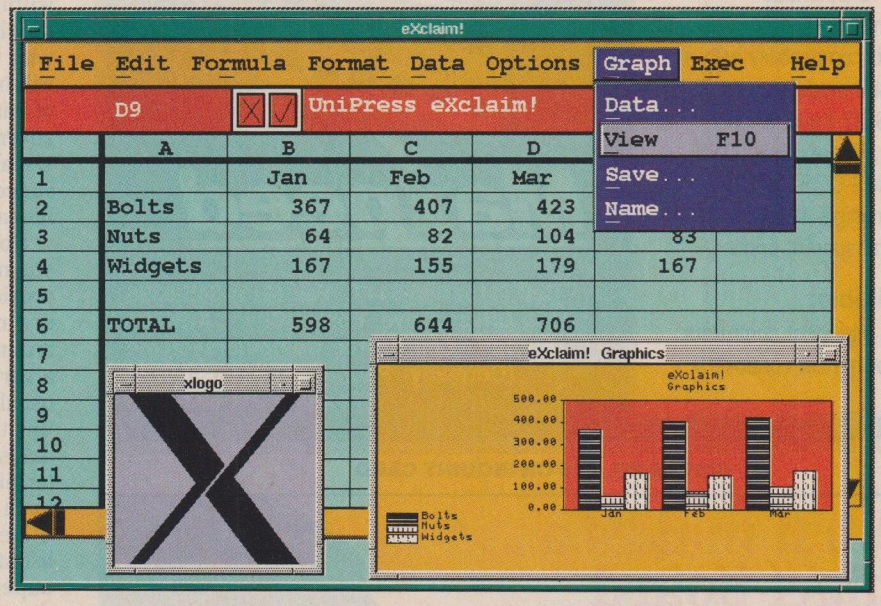

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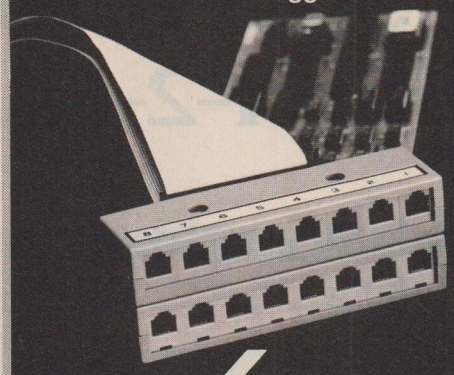

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fore you read that chapter and an overview of the chapter's contents. It ends with a summary paragraph or two, plus a quick-reference table of commands the chapter introduced. Utilities are summarized yet again in an appendix.

All this help, and coverage of 4BSD as well as System V UNIX flavors, makes even this book's large page count seem hardly adequate to present all of UNIX. The authors faced this problem by covering all the major areas within UNIX, but only the most commonly used aspects of each. Anyone who wants to become a UNIX expert will have to continue beyond the pages of this book. Even readers who act a bit adventurous at their terminals will occasionally stumble into a side effect or advanced feature that this book doesn't hint at.

Does this sound familiar? If it does, you must have read the Lurnix group's previous book, *UNIX for People*. There are major improvements this time around, though. The most noticeable is a very clear and slightly larger-than-usual typeface throughout. That makes this the first UNIX book I've reviewed that's easy to read even when I'm at my terminal, switching my focus back and forth between the pages and the screen.

Next most obvious is the very large list of topics covered. In addition to the expected points of basic UNIX use, there are complete chapters on setting file permissions, how the shell interprets command lines, the C shell's history feature, running UNIX on networks, the X Window System, aliasing with the C shell, and using the UNIX manuals. Many other important, but usually unexplained, features of UNIX are covered at less-than-chapter length.

The last improvement is a judicious selection of subjects. The text formatting chapter covers universally usable **`nroff`** rather than complex **`troff`**. The Bourne and C shells, both widely available, are featured instead of the rarer Korn shell. Editing chapters deal almost exclusively with **`vi`**, with just a little **`ex`** and no **`ed`**.

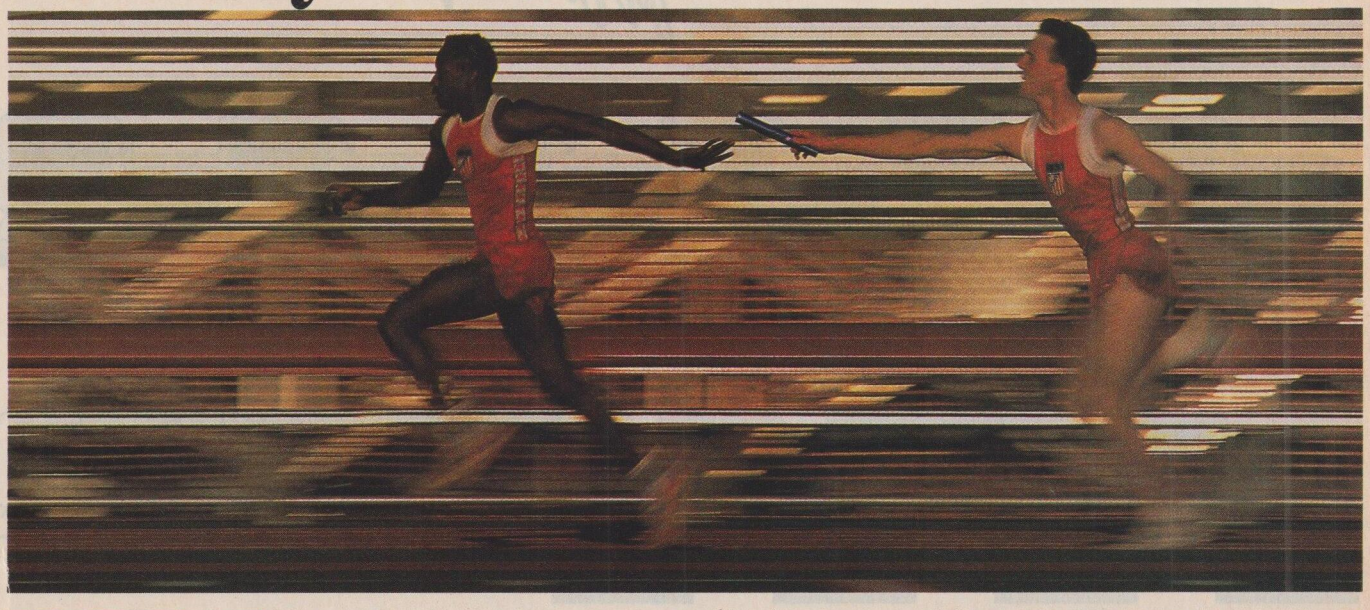
Review Highlights

Technical Level: Beginner to Intermediate
Understandability: Lucid
Summary: Gentle lessons in the basics of System V and 4BSD.

Editor-at-Large Walter Zintz is the Advisor Emeritus to Uni-Ops Books in Boonville, Calif.

DBMS Case Study:

Security for the Goodwill Games™*



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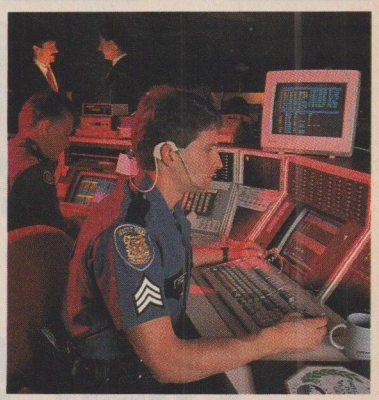

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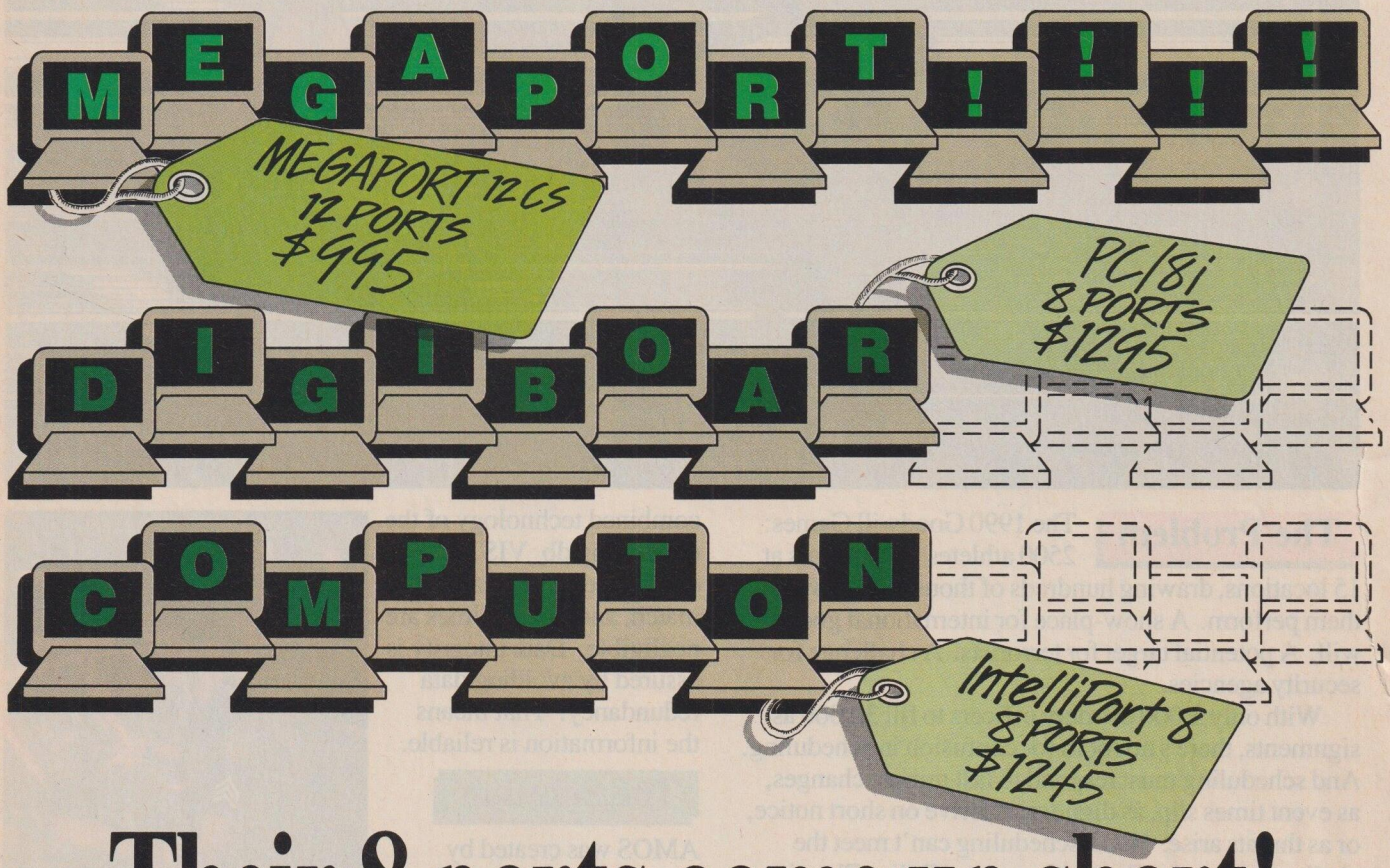

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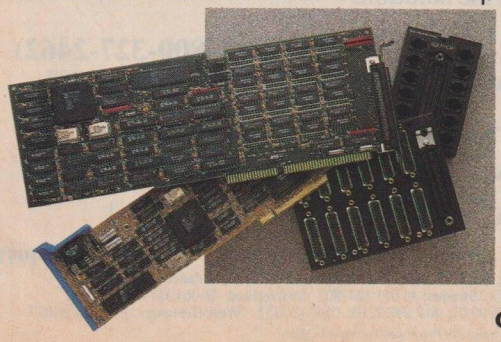

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OLTP FOR THE REST OF US

Two new products underscore the intense interest building up in providing UNIX-based on-line transaction processing (OLTP) solutions. They will also end AT&T's short reign as the only current major supplier of such a product (the Tuxedo System/T). At the same time, a significant change of technical direction at X/Open's Distributed Transaction Processing (DTP) standards group will make it easier than ever to integrate new UNIX OLTP offerings with existing systems.

The new OLTP UNIX products are expected from NCR Corp. and from Pittsburgh-based, startup Transarc Corp. NCR plans to officially unveil its product, currently code-named TPSX, sometime in the first quarter of this year. This product will be based on UNIX System V Release 4 (SVR4). The Transarc product, currently code-named Transarc-TP, is scheduled to be announced this quarter, and will be based on the Open Software Foundation's (OSF's) Distributed Computing Environment (DCE). Transarc hopes to offer versions for AIX, SunOS, Ultrix, OSF/1, and other UNIX systems.

NCR's TPSX: Mainframe Power Comes to Open Systems

Last year NCR made a major move to climb aboard the open systems movement with a new product line, the NCR 3000 series, based on the Intel 80X86 microprocessor family. While the low end of the line is clearly oriented to personal applications using the MS-DOS and OS/2 platforms, some of the midrange models and all of the high-end 3600- and 3700-level systems now being planned will be heavily oriented to database and transaction processing applications. They will offer UNIX SVR4-based software, including the soon-to-be-announced TPSX product.

But TPSX is more than just another applications platform for the NCR systems. NCR hopes to offer TPSX as a source-licensed product: one that is available to other hardware and software vendors who wish to customize or optimize the system for their own specific environments, and who can then sell it under their own label. Beginning last year, NCR has been discussing this possibility with a number of potential hardware OEMs and software third parties. No doubt if such discussions are fruitful, you will hear about it at announcement time.

As a general-purpose, SVR4-based transaction system, NCR's TPSX will clearly compete with AT&T's Tuxedo, currently the key UNIX-based transaction processing-oriented product. As noted in this column, virtually all of the leading relational DBMS vendors (and some key hardware vendors, such as Unisys) are rushing to provide Tuxedo System/T interfaces, either by internal development, or by working directly with AT&T or through Independence Technologies Inc. (ITI), which is marketing a System/T-based product. But, while the momentum favoring AT&T's Tuxedo appears unstoppable, don't be surprised to hear that at least one of the RDBMS suppliers will also be working closely with NCR to provide an especially efficient implementation of its product integrated with NCR's TPSX.

NCR and Transarc are ending AT&T's reign as a major OLTP supplier

TPSX traces its roots to Multi-Tran, the transaction processing monitor developed expressly for the NCR 9800 line of multiprocessor systems. The 9800 line, based on NCR's own proprietary microprocessor technology, did not find much favor outside the limited circle of NCR's existing customers. Only about 200 of the total 9800 sites actually use Multi-Tran. However, by recasting the product in ANSI C, and by re-engineering it to match the evolving X/Open DTP standard suite, NCR believes it has created a portable and cost-effective OLTP product with wide market appeal. Indeed, NCR says, "TPSX is the first product to bring mainframe-class OLTP capabilities to Open Systems."

X/Open DTP Redirection: Controversy Avoided

One key characteristic of TPSX is the degree to which it can be made to work with existing communications architectures and interfaces. This has been greatly aided by the recent redirection of the X/Open DTP standards.

Previously, the proposed DTP model visualized three key components: the application program (AP); the resource manager (RM, typically a database manager or a file system); and the transaction manager (TM).

In this model, the TM was to provide not just global transaction management functions, including the management of the requisite two-phase commit protocol, but also all communications functions as well. The command interface between the RM and TM (the so-called "XA interface"), as well as that between the AP and TM, included the communications primitives necessary to support distributed atomic transactions.

Last year, however, with support from NCR and others, the X/Open DTP group abandoned the idea of embedding communications within the TM. Instead, the group opted for allowing communications services to be treated as a fourth component of the DTP model, the so-called communications resource manager (CRM). Consequently, an additional set of interface calls, the so-called XA+ interface between the TM and CRM, is now being developed by the DTP group.

There are several key advantages to the new scheme. First, it minimizes greatly the effort needed to develop the brand-new TM component. Furthermore, by allowing existing communications services to serve those functions, the need to make the very controversial choice between the IBM-favored "peer-

to-peer" protocol LU6.2 and the ISO-and-UNIX-favored remote procedure call (RPC) approach has been shelved. In the new model, either one can be used.

Finally, the application can now avail itself of communications services by talking directly to whatever CRM component is available, over whatever interface has been defined for that component by the vendor or installation. This not only adds a measure of symmetry (after all, the application can talk directly to the RM, over the SQL interface, for example), but also assures that the introduction of DTP-compliant software will cause the least possible disruption to existing applications and installation procedures.

The public review period for newly revised XA interface calls document is slated to close this month. If all goes well, formal publication of this portion of the DTP standard is expected around March.

From the application builder's point of view, TPSX in its most basic form appears in the context of the familiar, monolithic UNIX process, in which the application, RM, TM routines, and communications functions ("Client-Server Interaction" or CSI) share a single address space. The AP communicates with the RM over SQL and the CSI over existing standards for the "Dialog Interface" (DIF). The only new element for the AP is the TX* interface calls to the TM services. The XA and XA+ interface calls for CSI-TM and RM-TM communications, respectively, are "hidden under the covers" as far as the AP is concerned.

While TPSX will run on tightly coupled multiprocessor systems, it is oriented principally to loosely coupled architectures, such as the ones NCR is now developing in its 3600 and 3700 high-end systems. Both these systems are derivatives of the current Teradata back-end database machine, with a number of significant architectural and packaging revisions. You are likely to hear more about these systems later on this year.

OLTP Fever Spreads to OSF

Meanwhile, the OSF camp is also preparing to enter the OLTP arena via the Transarc-TP announcement, expected shortly.

Transarc is a small, Pittsburgh-based startup launched in mid-1989 with financial support from IBM. Its current product is AFS 3.0, a commercial version of the Carnegie-Mellon-developed Andrew File System. The next generation, AFS 4.0, has been selected by OSF as its standard data sharing component of DCE. But Transarc hopes that its coming transaction processing product will be a blockbuster.

Unlike the AT&T Tuxedo and NCR TPSX, Transarc-TP will be aimed squarely at the Distributed Computing Environment (DCE) scheme, recently adopted by OSF as its standard approach to distributed computing. Transarc-TP will be the first OLTP-oriented product that will work with that environment and the underlying OSF Mach-based UNIX kernel.

Transarc-TP has its roots in the Mach-based Camelot distributed trans-

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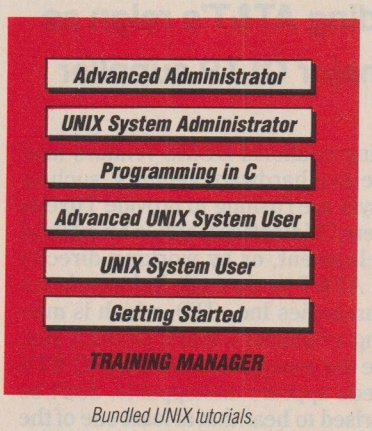

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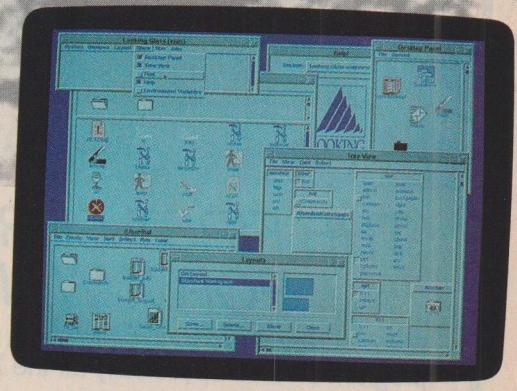

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CIRCLE NO. 165 ON INQUIRY CARD

action processing research project, conducted for a number of years at Carnegie-Mellon University under then-Professor Alfred Spector, who now heads Transarc. Camelot took full advantage of the Mach threads and other distributed features in Mach. Versions of the research prototypes of Camelot were tested on IBM RT PC systems as well as DEC VAXen.

Transarc-TP is expected to be a much more robust, commercial-grade product. Furthermore, it will rely much more heavily on procedure calls for communications within the context of a local node; the research version relied exclusively on message-passing, which is usable for either distributed or local communications, but detracts from performance in the latter case.

The Transarc product is expected to be quite modular in nature, and hence reasonably adaptable to other environments. It will include a "base development environment" (BDE) layer that is designed to interface the higher-level Transarc-TP components to whatever underlying kernel is available. An intriguing possibility for such a kernel: UNIX SVR4.

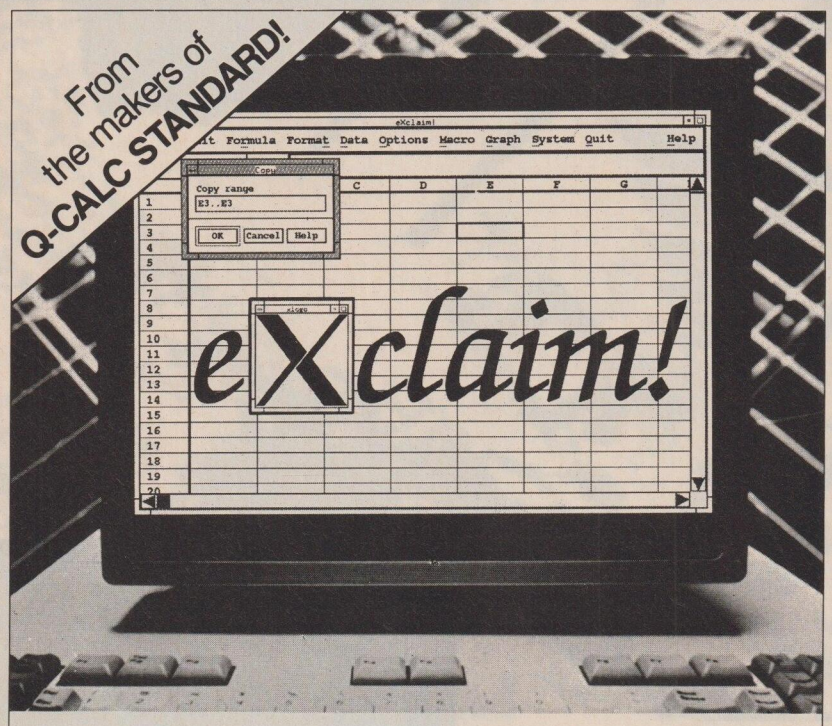
In addition to the BDE, key components of Transarc-TP are as follows. The distributed transaction service (TRAN) supports nested transactions, coordinator migration, and presumed-abort commit protocol over NCS 2.0. The transactional communications (TCOMM) component relies on the HP/Apollo NCS 2.0 Remote Procedure Call standard, which could be supported on other-than-OSF systems. Also, an optional CPIC/TPC API is provided with two implementations, one utilizing IBM's LU6.2, while the other uses TCP/IP.

The logging service (LOG), required for assuring transaction recovery, can be provided in various forms, and even through a process running on a remote system. The lock manager (LOCK) provides for serializing multiple accesses to common data. Transactional-C is a C dialect supported by specially enhanced C library and a set of macros tailored for transaction applications. The recovery service (REC) implements the necessary undo/redo logic to permit recovery from server, local node, or disk failures. A Transarc-developed structured file system (SFS) utilizes the recovery, locking, and logging components to provide record-oriented data storage. Finally, components and tools are included to support simplified application development and system administration.

To top it all off, Transarc promises that it will provide X/Open DTP compatibility in some form, as the DTP standards emerge.

Given this broadening diversity and choice of UNIX-based OLTP products, it's a sure bet that UNIX is well on its way toward far greater acceptance in commercial production applications. ■

Editor-at-Large Omri Serlin heads ITOM International Co., a consulting and research firm based in Los Altos, Calif.



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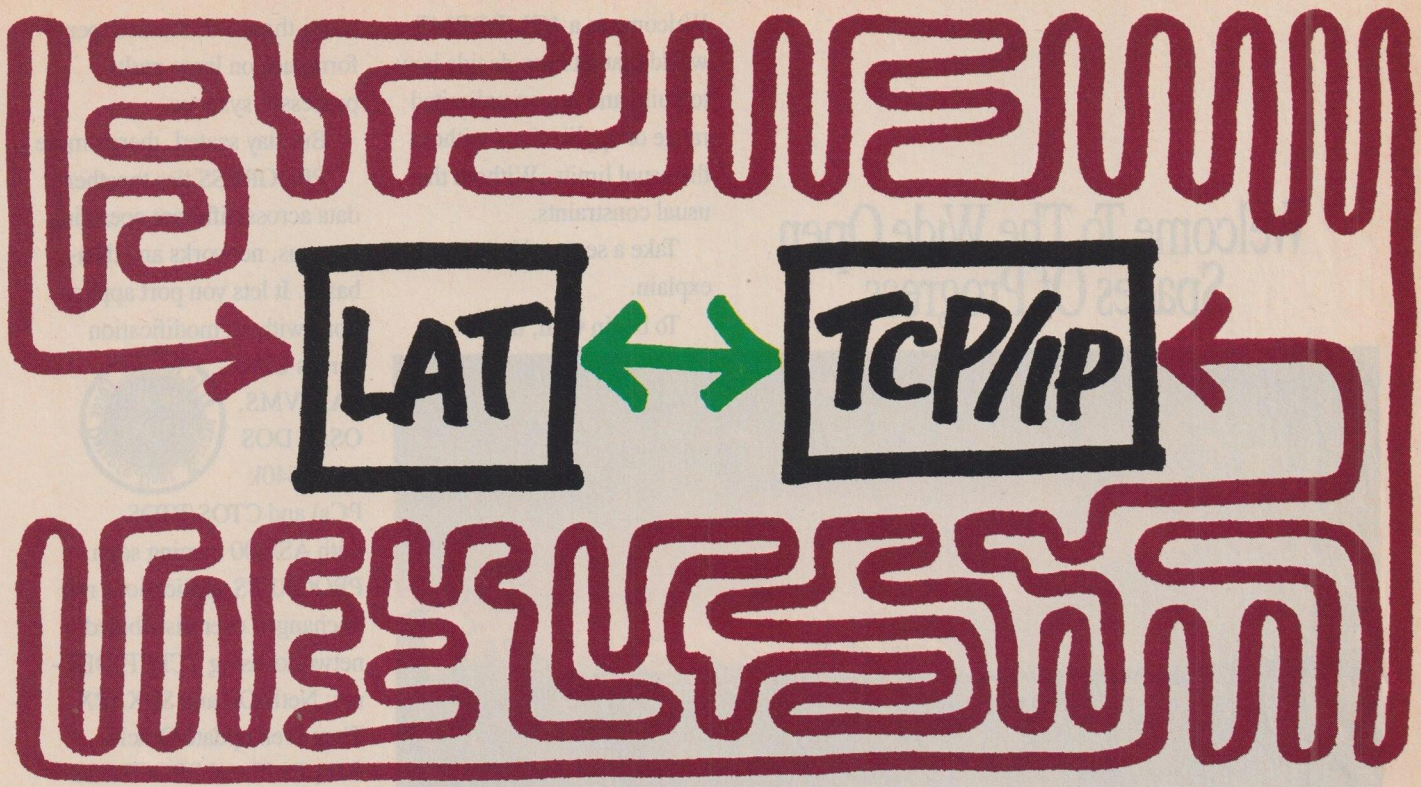

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CIRCLE NO. 59 ON INQUIRY CARD

The Best Products of 1990

This month we present our editorial staff's choices for the best UNIX hardware and software products of 1990.

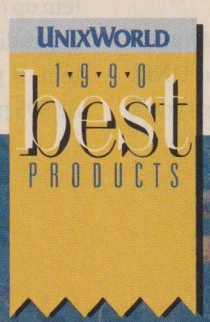
By Howard Baldwin

Of the thousands of products that came to our attention during 1990, 10 products are outstanding in their ability to meet our criteria. UNIXWORLD's requirements were that these products be UNIX-based, that they represent an exceptional technological achievement, that they be commercially available, and that they significantly contribute to productivity.

Not that they are perfect, mind you. Past criticisms of UNIX-based products for being hard to use–except by programmers, scientists, and engineers–are still valid. As you will see, however, in the past year these products have made tremendous strides in giving application developers, data processing managers, and information executives exciting new power to access, control, and distribute information.

As UNIX users ourselves, we congratulate the winners for offering us products to lighten our load and improve our work.

David Flack, Editor-in-Chief



FRED STIMSON

Access Technology's 20/20 RealTime Spreadsheet

In the world's financial centers, it's not enough to know the numbers–you need to know what they mean. With Access Technology's 20/20 RealTime Spreadsheet, you can sit at a workstation running Sun's Open Windows and dip into the digitally fed data from the New York, or the Tokyo, or the London Stock Exchanges, and crunch all you want. Prices start at $1,800 for a SPARCstation version, with more platforms to come.

Access Technology has customized the drivers that feed the data into your system. That means a "data dictionary" on your particular industry (such as finance, metals, or minerals) can be directly installed in your system.

Now you can designate when and how you want to be notified when information changes in a particular cell of your spreadsheet. The news can be delivered by pop-up window, or by simply highlighting the appropriate cell. You can ask for new information when the spreadsheet recalculates, or at whichever intervals that you choose. If you're tracking a particularly volatile stock or commodity (oil leaps to mind), you can even request immediate, real-time notification.

To digest all this information, you may want to keep track of the numbers. The spreadsheet lets you specify ranges for previous data, so that you can calculate averages and perform what the MBAs call time series analysis. A 20/20 database connection lets you put numbers in and get numbers out of the Big Four UNIX databases (Informix, Ingres, Oracle, and Sybase).

AT&T's Rhapsody System

There are about 20 million DOS-based PCs out there on the hit parade, and anyone who can make them sing along with UNIX has the right idea. AT&T's Rhapsody System orchestrates a new concept of client-server computing that makes sense for the 1990s: run single-tasking DOS on the desktop where the single user sits, and run AT&T's LAN Manager for UNIX (LM/X) on the server, where multiple users are accessing data.

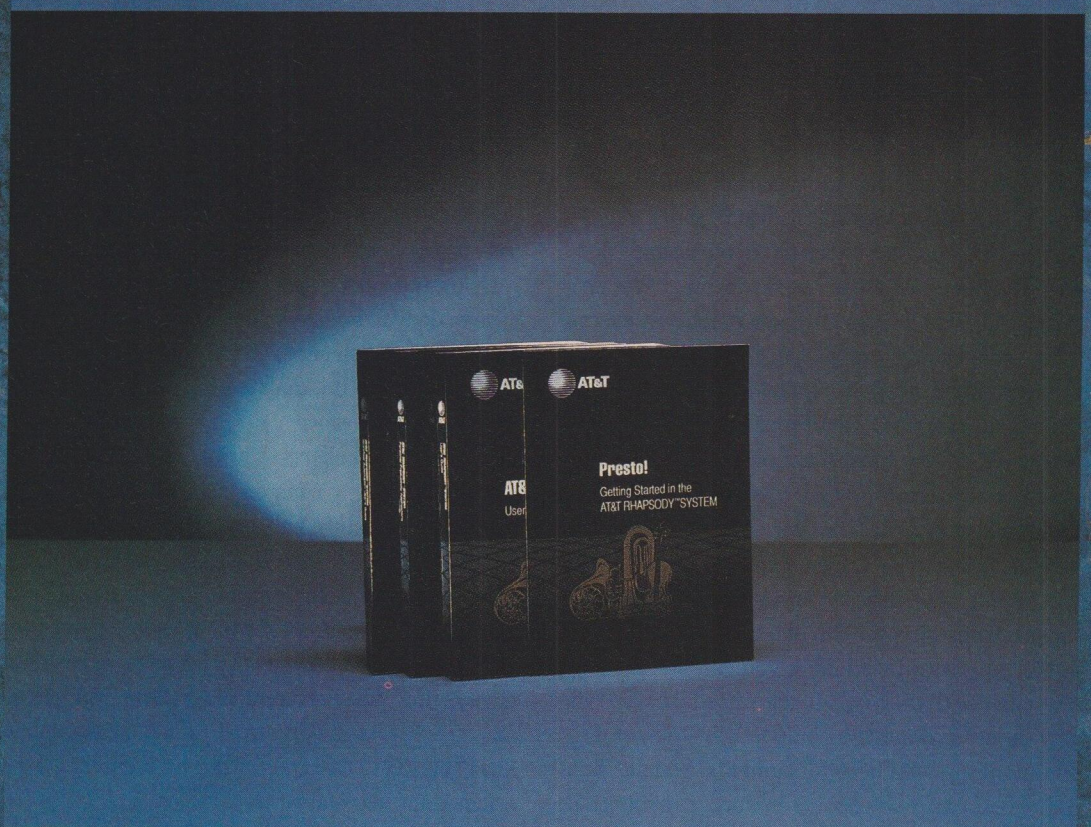
Rhapsody is more complicated than LM/X, and is aimed at the experienced systems administrator. While the DOS client side incorporates the reigning champions of ease-of-use–Microsoft Windows and Hewlett-Packard's icon-based NewWave environment (NewWave for UNIX won't be out until later in 1991, by the way)–what's on the server side is just as impressive for the UNIX world.

At the heart of Rhapsody is a workflow automation system from Dublin, Ireland-based UNIX developer Workhorse Systems. Here's where you'll find the traditional players in integration office automation, like calendar, Rolodex cards, to-do list, and the library of common documents. But you can also use Workhorse to create a computerized workflow for office projects and procedures.

As you'd expect in a client-server-based system, you have lots of access: electronic mail between users, to Informix's RDBMS on the server, and to a corporate catalog of users, through a distributed directory service. You can also fax any printable object by dragging it over to a fax-machine icon.

Add to that SNA connectivity and three sets of administrative tools (depending on your level of expertise), and it's quite an arrangement. It also has quite a price tag: $99,995 for a 20-client system. That's about $5,000 per client, but getting the system up on the DOS side costs from $7,295 to $8,795, depending on whether it's a 286- or 386-based system. If you already have the PCs, the software is $2,995 per machine.

2020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IBM's RS/6000

With its RS/6000 (RS for RISC System) line of POWERstation workstations and servers, IBM finally has a serious UNIX strategy to obtain market share.

This is Big Blue's third entry into the workstation market, and the third time's the charm in this case. Four models make up the POWERstation line, from the desktop 320 ($12,995) to the deskside 520 ($27,245), 530 ($42,705), and the top of the line 730 ($73,815). The 730 has the same base memory and storage as the 520 and 530 (each with 16 megabytes of RAM and 355 megabytes of storage), but it has a souped-up graphics subsystem. IBM continues one of its mainframe traditions by manufacturing its own components, from the RISC processors to the MicroChannel to AIX, IBM's version of UNIX.

Take the MicroChannel bus, which originally appeared in the PS/2 line. By installing it in the RS/6000, IBM enables third-party vendors to manufacture peripherals for both PCs and workstations; ultimately, that will translate into lower costs of those peripherals for users because there'll be a wider marketplace. Important in a different way is IBM's significant improvement of the bus's data transfer capabilities. You'll see I/O burst-rate performance on the workstation almost twice what it is on the PS/2 (19 megabytes per second vs. 37 megabytes per second).

As for AIX, while some users have complained that it's strayed too far from UNIX's roots, you'll nevertheless find some compelling advantages. For instance, you can increase the size of a file system while it's mounted, something UNIX won't let you do.

IBM's persistence has paid off. Dataquest analyst Kathleen Hurley expected IBM to capture 5 percent of the 1990 workstation market, up from a scant 2 percent, "and that's after only four months of shipments," she notes. Demand has been so intense that the company has opened up manufacturing facilities in Australia and Italy to fulfill orders, she adds.

Interleaf's 5

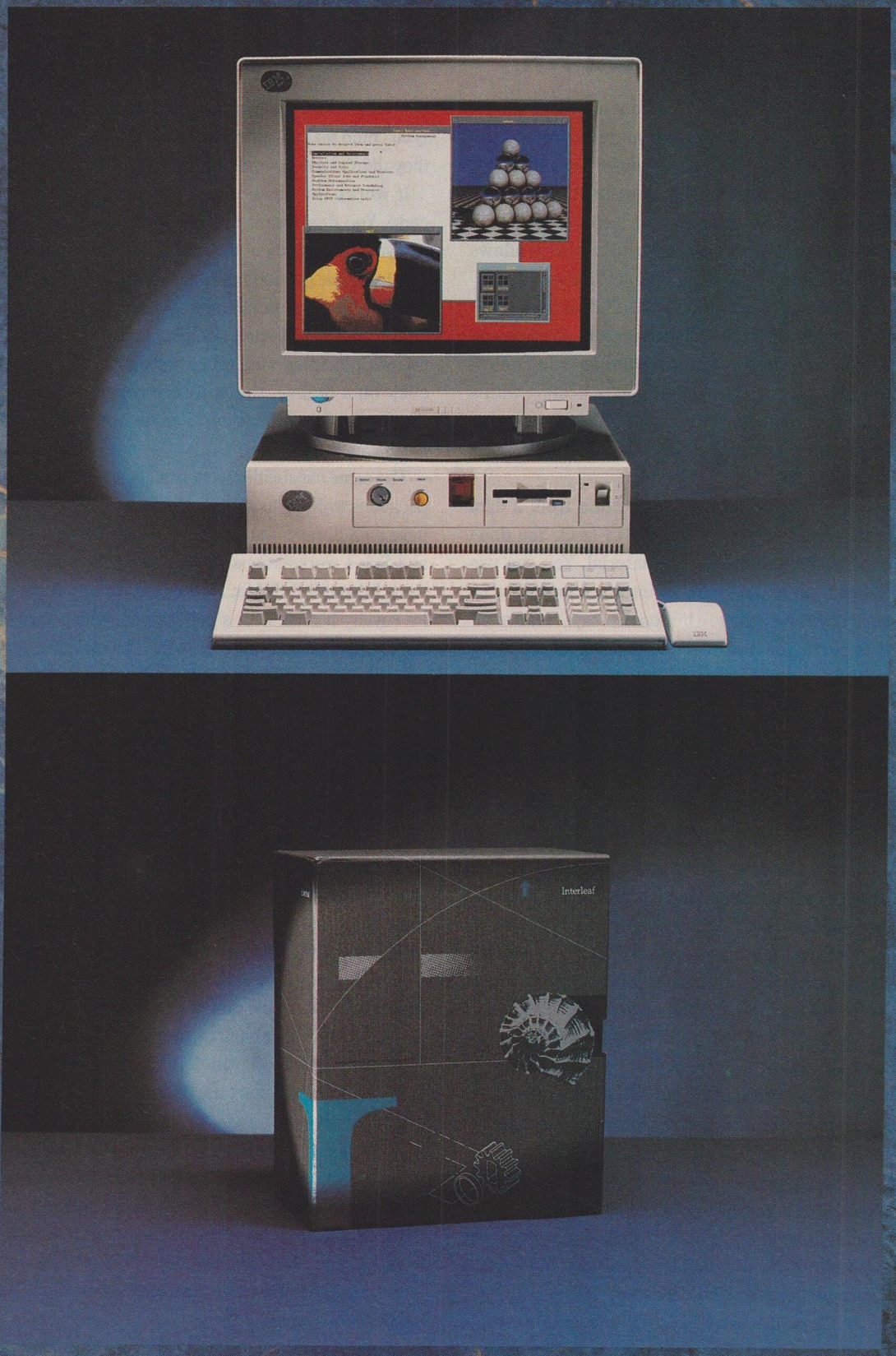
At its most fundamental, UNIX's blessing is its ability to run on different platforms. What's been lacking is software that takes advantage of that concept and incorporates information into a single document using data that resides on different machines. Data, in this case, encompasses everything from text and graphics to video.

Say you had a repair manual that included text and actual video of how to repair a jet. While the text could fit in a hard drive on a workstation, it would be more cost-effective to store the video portion on an optical disk server somewhere on the network. Interleaf's active document product lets you tap into those different machines and build documents from the most current data available.

Working with Interleaf 5, you can imbue your document with the intelligence it needs to wend its way in and around the computer system, and to communicate with other documents. You can link individual expense reports to spreadsheets that communicate with overall departmental expense reports, or you can create documents from database information that update the originating database if you or another user amends information.

Using the video repair example again, all you'd have to do with updated video information is load it on the optical disk server. The technician will automatically access the updated information over the document link.

Software that collects information from disparate machines but only runs on a single platform is an oxymoron, certainly. Interleaf's initial platforms are HP/Apollo, IBM, and Sun workstations, and Apple and 386-based personal computers. Interleaf 5 comes in five different formats, each targeted toward different professions (for instance, publishing, engineering, manufacturing, illustration), with prices for the software ranging from $2,400 for the entry-level version to $16,000 for the high-end software oriented for manufacturing.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IXI Ltd.'s X.deskterm

X Windows-based applications are surging onto the desktop, but they're far outnumbered by the character-based applications you've been using for the last 20 years. If you could make X take advantage of that investment, you'd have an easy path from the character-based world to the windows world. Perhaps that's the point of Windows 3.0.

It's also the goal of IXI Ltd.'s X.deskterm, built to help you move an application from character to X. You can use X.deskterm whether you control the source code, or whether you're dealing with a computer language without an X library, or with a proprietary operating system that doesn't support X directly.

Say you're receiving information from a data feed, such as a news wire or MCI Mail. You don't control the source of that material. You can use X.deskterm to configure an interface for it. For instance, you can create a button that says "read mail" that performs however MCI Mail expects. One British company, Altered Image, used X.deskterm to create a Motif-based front end to Informix-SQL (you could do the same with Open Look); naturally, they didn't have access to Informix's source code.

It works the same way if you own the source code. You don't want to necessarily embark on a two-year R&D project to build an X-based application from the ground up. You can use X.deskterm, which acts as an intelligent terminal emulator, to create an X-based shell (Uniplex has already done this with its integrated office software). When you click on a mouse, the software reports back to the application and requests an escape sequence, for instance.

The same capabilities let you adapt proprietary applications to X, or to access a language that doesn't have an X library. You can run X.deskterm on Sun-3 and Sun-4 workstations, NCR Towers, and on PCs using Interactive's 386/ix. It's licensed via a developer's kit royalty license with a per-seat fee, which varies according to the number of seats. For example, for more than 100 seats, the cost is $60 per seat.

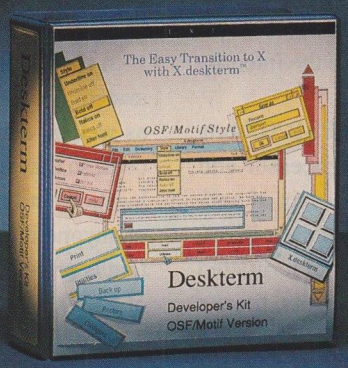
Legato Systems' Networker

First off, let's admit that there's always something more exciting to do than to back up files–maybe not more important, if it turns out that you have to restore one, but more exciting. Because computers are supposed to take the drudgery out of a lot of the administrative things we do, software like Legato's Networker, which automates this chore, is the technological equivalent of the microwave.

Taking the place of UNIX shell scripts using **cpio** and **tar**, Networker lets you back up and restore files across your network. It takes advantage of client-server architecture so you can back up not only different UNIX platforms (Sun, Solbourne, HP, DEC, and MIPS), but DOS machines too. Part of Networker's software resides on the client, routing files that need to be backed up to the server. The server, meanwhile, maintains an index of file backups and their associated location.

While you or your system administrator can set up scheduling via the UNIX **cron** command, say to do a full backup on Sunday and incremental backups the rest of the week, Legato has designed the on-line index so that other users can go in and restore documents they need, as well. It allows you to browse until you find the file you're looking for, and, assuming you're in "recover" mode, click on its name to request the server to deliver it back to your client at the desktop. Just so you don't think it's lying down on the job, the message pops up, "Requesting two files–this may take a while."

The basic Networker software, running on a SPARCserver or Sun-compatible workstation, costs $4,995 (there's also an entry-level version for smaller networks for $2,500). Depending on whatever DOS or UNIX-based system you have, you can purchase the software necessary to back those up at $300 per system.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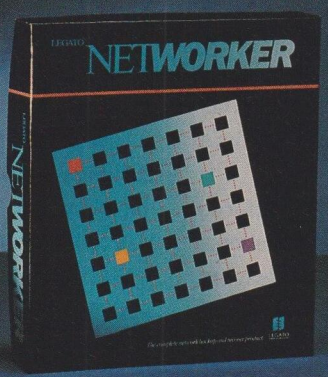

DESQVIEW
NETWORKER

Tandem Computers' Integrity S2

If HAL had been designed by Tandem, *2001: A Space Odyssey* might have ended differently. Its fault-tolerant Integrity S2, the first such machine whose operating system is based on System V Release 3, can without human interference dial an online support center to dispatch a replacement part by overnight delivery. If your business requires 100 percent uptime, a tour of what's inside the Integrity S2 cabinet is quite educational.

The machine's three redundant MIPS R2000 processors feed into two redundant processor and memory modules and then into a pair of self-checking I/O processors. On the two disk drives, you can have 295 or 650 megabytes of formatted space. Other than their redundant facets, there's nothing surprising about any of this.

What's exciting is that the Integrity S2 is designed so that even a non-technical employee, having checked either the system console or the internal control panel, can remove any of the components–whether it's one of the boards, the drives, or the batteries–while the machine is running. It can even be done with two of the three fans running–you'll hear a momentary surge while the remaining fan compensates for the ones you've removed, but, other than that, it keeps on rolling.

In the System V-based NonStop-UX operating system, you'll find the Berkeley Fast File System as well as several enhancements for remote access, so that you can do diagnostics from a remote location–and make sure the machine isn't talking to anyone it isn't supposed to. The operating system is priced separately, with an initial license fee of $12,000 and a monthly license fee of $400. The price of the Integrity S2 ranges from $172,000 for the entry-level system to $248,000 for the model with two storage cabinets, four 295-megabyte disks, and four SCSI controllers.

Touch Communications' Worldtalk/400 Gateway

While the CCITT's OSI (Open Systems Interconnection) standard has yet to experience widespread implementation in the U.S., one facet of it is a big success: the X.400 worldwide electronic mail standard. Touch Communications' Worldtalk/400 Gateway lets UNIX users tap into X.400 messaging services. It incorporates both SMTP (simple message transfer protocol) and UUCP (UNIX-to-UNIX Copy Protocol) so you can exchange messages between the Internet and such services as Dialcom's Pathfinder/X.400 and Sprintmail 400.

What the Worldtalk/400 Gateway also affords you, if you're in the public sector or a multinational company, is the capability for linking messaging systems across your enterprise. Hooking the Gateway to a corporate or public X.400 network backbone, you can cross over to disparate mail systems, whether DEC's All-IN-1, IBM's PROFS, or MCI Mail, among others. From an administrative standpoint, it also allows you to collect statistical data on the message traffic going through the gateway, and to create files tracking user activity, connectings, and–especially important when it comes to worldwide communication–billing.

Touch is licensing the software for $8,000, plus $2,000 for each messaging gateway. You'll need a 386-based machine with at least 8 megabytes of memory and 100 megabytes of disk storage. You can also get a complete turnkey system starting at $25,000, composed of a 386-based machine running with Interactive Systems' 386/ix and an intelligent X.25 adapter.

TANDEM
TANDEM
WORLDTALK
Worldtalk 400
Gateway for SMTP/UUCP
User's Guide
TOUGH
TOUGH

Visual Edge's UIM/X

Another advancement in the world of X this year came with graphical user interface (GUI) builders, tools for programmers building X Windows-based applications. If you're an independent software vendor torn between warring GUIs, Visual Edge's UIM/X (User Interface Management for X Windows) offers a wonderful olive branch: support for the widgets, gadgets, and menus of both OSF/Motif and AT&T Open Look toolkits. It comes with a reusable library of style guide components, but you can also customize your own.

With UIM/X you can start positioning and sizing components of the GUI, typing in menu entries as you go, adding boxes and buttons. These components are built out of the appropriate widgets. Then you instruct UIM/X's ANSI C interpreter to generate C code and prototype the link between the user interface and the application, even while you're running the application. One time-saving step: when you're testing the work you've done, you can continue to modify the GUI without recompiling and relinking the application.

UIM/X also allows you to build GUIs for the terminal-based applications you already have, without restructuring them. It simplifies the job of programming so that even if you're not an expert in programming X, you can get started building the interface. Note: this is different from IXI's X.deskterm in that you must have the source code to complete using UIM/X. Price depends on which of the 10 OEMs you purchase from, but it ranges around $5,000.

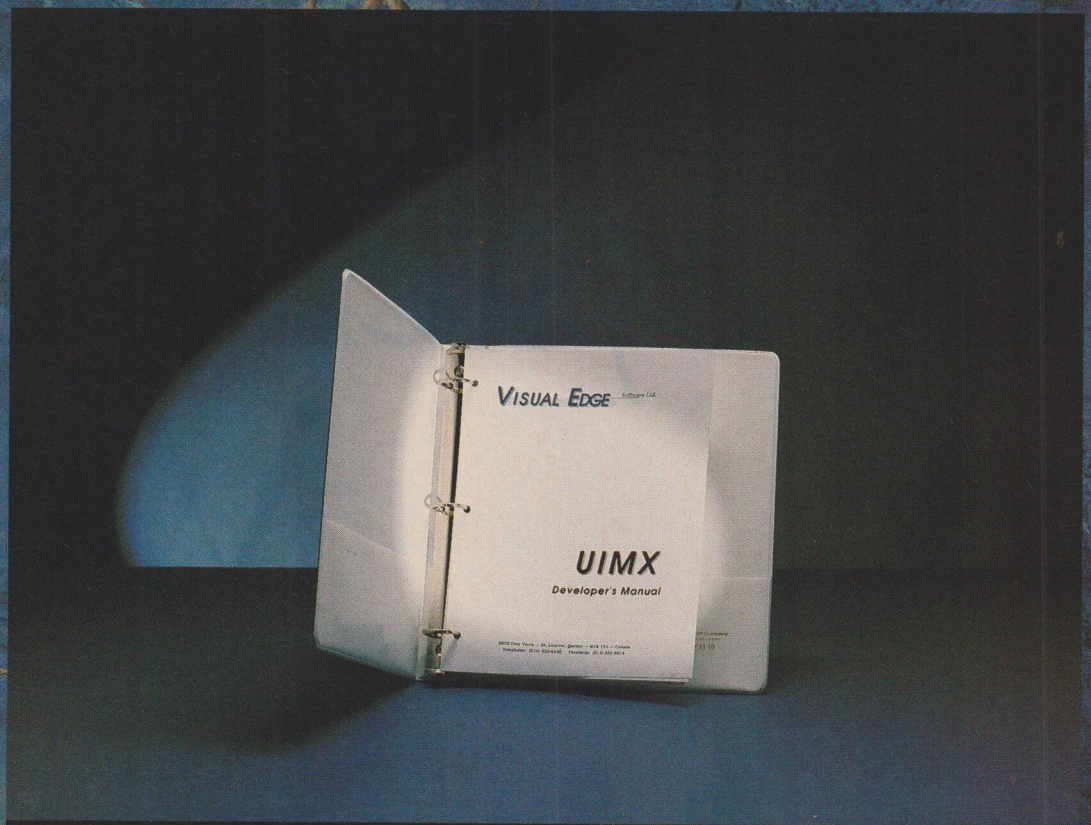
Wyse Technology's 9000i

In a year when symmetric multiprocessing became a major buzz word, Wyse made a big contribution with its 9000i multiuser computer. While Compaq's Systempro is only a dual-processing machine, you can stuff the 9000i with up to six processors. The Wyse 5000i, its smaller multiuser counterpart, is a single processing machine, but both the 5000i and 9000i are upgradeable through board-swapping to the 486 today and to the 586 when it arrives in 1992.

Wyse has improved performance by changing the way buffer cache memory is allocated, with a dynamic system that creates larger caches based on disk memory usage. In addition, it has devised a way to vary the length of time each process has with the CPU, depending on how many people are using the system. Its technique balances the system so that fewer users get access to more processing power, and when the system is more heavily used, those users get better response time.

On a 386-based machine, you can run up to 128 users. You can also attach a smorgasbord of I/O devices: up to 11 VMEbus-based devices, up to 14 SCSI devices, and, if you install Wyse's intelligent terminal concentrator, anywhere from nine to 288 serial connections for printers, plotters, and modems.

Because the 9000i is Intel-based, it runs most Santa Cruz Operation-compatible software under Wyse's version of AT&T UNIX System V/386, Release 3.2, and DOS applications under SCO's VP/ix. Prices for a two-processor 9000i start at $74,000, and go up to $176,000 for the six-processor system.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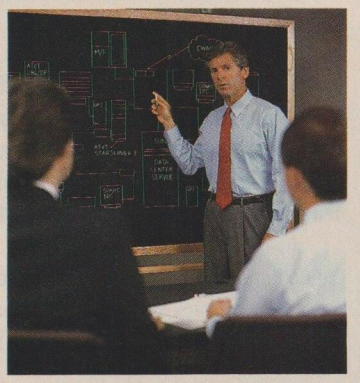

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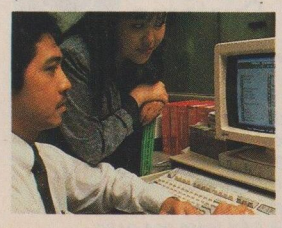

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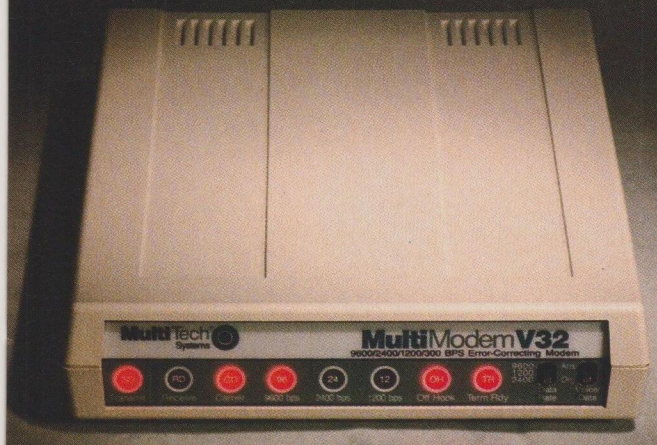

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Kodak Sharpens Interactive's Focus

BOB WAGNER

Kodak hopes that Interactive's software experience will help it set the standard for Photo CD. Former Interactive CEO John White (left) heads Kodak's Software Systems Division, while Dennis Peck (right) is Interactive's new chief executive.

Can a UNIX porting house give Kodak the tools it needs for digital computing?

By Michael R. Leibowitz

About two miles from the ocean in Santa Monica, Calif., sits a small software firm that may be the future of Eastman Kodak & Co.'s photography empire. Executives at the 400-employee Interactive Systems Corp. never thought their company would play such a strategic role in the photography business when $20-billion Kodak acquired the cash-strapped company in 1988. But this UNIX pioneer–the industry's premier porting house–has emerged as a central figure in the photo giant's strategy to cross the gap to the digital world.

It's a bridge that Kodak desperately needs to build. Photographic film, chemicals, and paper–150-year-old technologies that form the pillar of Kodak's business–are on their way to obsolescence by the relentless advance of the digital age. Already, filmless, all-digital cameras have appeared from Japanese giants such as Canon and Sony. These cameras store images on a miniature floppy disk and display them on television sets. All it takes is the inevitable price reduction that dig-

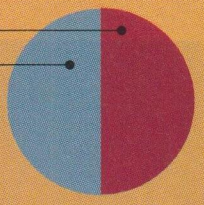
Interactive's Product Sales Increasing

Over the next three years, Interactive expects sales of products to make up an increasing portion of the company's revenues.

1990 sales: $60 million

UNIX consulting, porting, and technology licensing: **50%**

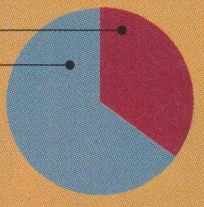
Standard products (mostly UNIX 386/486 products): **50%**



1993 sales: $250 million*

UNIX consulting, porting, and technology licensing: **35%***

Standard products (mostly UNIX 386/486 products): **65%***



*Projected

SOURCE: Interactive

Kodak's UNIX System Plans

The following is a sample of Kodak systems that currently run on UNIX or will be ported to UNIX in the future.

Photo CD transfer station

Based on Sun Microsystems' SPARCstation, this system transfers 35-mm film to Photo CD.

Atex publishing systems

This word processing and layout system for publishing firms will be ported first to IBM's RS/6000-based workstations.

Kodak Legal Systems

These document management systems for law firms now run on Digital's DECstation 2100 and DECstation 5400 running Ultrix, Sun's SPARCstation 1, and 386 clones running Interactive's UNIX.

Kodak Imaging Management Systems

Providing document management for offices, KIMS now runs on DEC VMS and IBM non-UNIX systems. A UNIX system is planned.

Optistar Data Retrieval System

The product retrieves information stored on 8-mm digital tape using Sun SPARCstations.

ital electronics promises, say those who follow the industry, and traditional film technology will have had its heyday.

The Interactive acquisition, made for an undisclosed amount, was designed to give Kodak badly needed software experience for a wide variety of office systems that handle and store digitized images of everything from legal records to insurance forms. These products include elaborate document retrieval systems, which Kodak has spun from its traditional microfilm archiving business. "We recognized that software was one of the critical skills we would need in order to be successful in the future," says Lawrence J. Matteson, chief of Kodak's Imaging Information Systems sector.

"We were trying to change, fundamentally, the way we've been doing things in software development," explains John P. White, the former Interactive CEO, now head of Kodak's Software Systems Division. The division includes Interactive, a subsidiary

With its acquisition of Interactive Systems, Kodak reaps the software support critical to its future success–and standardized Photo CD

called Atex that produces word processing and layout systems for publishers, and several other software-intensive systems and subsidiaries. Kodak's software development efforts have traditionally been slow, expensive, and closed, according to White. Now it has to rapidly crank out applications, drivers, and other UNIX software for a new set of open, portable networking-oriented products.

Already, the 13-year-old company has contributed to Kodak's emergence as a software developer, one which spans the UNIX, Digital Equipment Corp.'s VMS, and IBM proprietary operating systems. One example of the new capability is a demo system Kodak developed in just six months, using personnel at three company sites. The demo, which uses a modular UNIX platform and integration tools created by Interactive, captures an image with an electronic camera, passes it down a high-speed Integrated Systems Digital Network (ISDN) to a computer screen, manipulates it, crops it, and sends it to a computer for storage and printing on a thermal printer. This is the kind of capability Kodak might provide to customers in the future, says White.

Over the Rainbow: Photo CD

But perhaps the biggest fruit of the Interactive acquisition wasn't even envisioned when it was made. It is support for standardizing Photo CD, Kodak's recently introduced technology that stores high-quality color film images on a compact disc.

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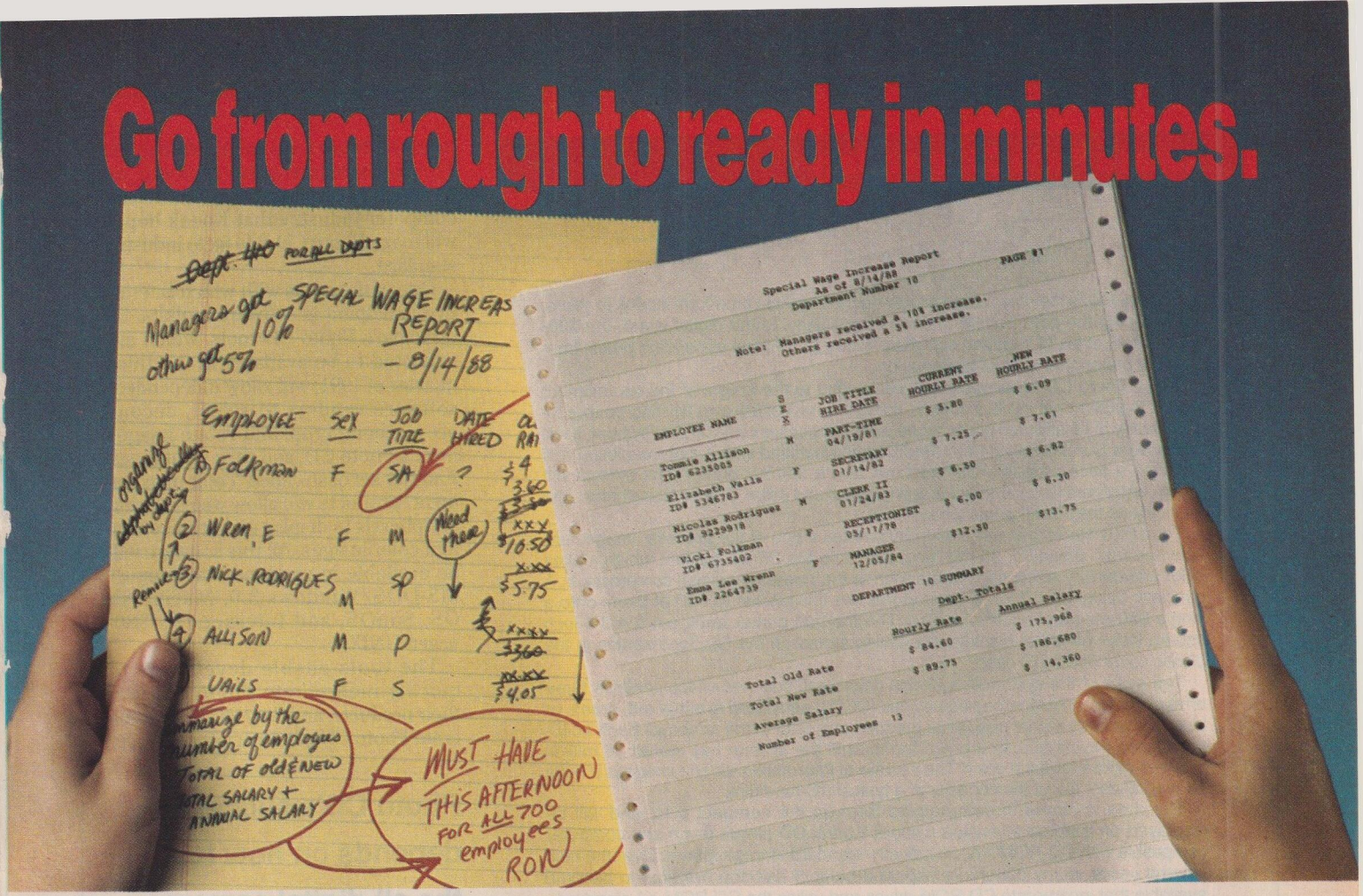

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Kodak's Photo CD Technology

Photo CD is the most strategic new technology to come from Kodak in years. By providing the path from film, Kodak's specialty, to the digital world, the $20-billion, Rochester, N.Y.-based company hopes to continue generating profits from the very materials it built its business on.

And if Photo CD is successful, it will be due to the weight of the commitment Kodak is putting behind it. Kodak is doing the necessary arm twisting so that by 1992 many of its affiliated photo processors will possess a $100,000 system. It will comprise a Sun Microsystems SPARCstation outfitted with a high-resolution film scanner, a once-writeable CD machine, and a thermal printer. The system will allow consumers to go to their local processor and order CDs of their photos, just as easily as they order prints today.

The UNIX-based transfer station automates much of the process. Images are scanned from standard, 35-mm negatives into the SPARCstation, which makes color and density corrections and performs the necessary digital compression. A specially designed CD writer then stores the images–up to 100 of them–onto a single 650-megabyte compact disc. The thermal printer turns out a 4 3/4-inch square index print that displays everything stored on the CD, for insertion in the plastic cover of the CD case.

The heart of the system is a Kodak-developed scanner, which contains three arrays of silicon charge-coupled devices (CCDs) sensitized to either red, green, or blue (the primary colors needed to produce any color in the rainbow.) Each 2048-pixel array travels across a given frame until the system has stored 18 million pixels–6 million for each color. The volume of information for one image is a hefty 18 megabytes, about the capacity of a typical PC hard disk.

The data is stored in compressed form on the compact disc, and will be displayed on a home television using a Kodak CD player or on any computer compatible with CD-ROM XA, an industry-standard storage format. Over the next several years, many observers expect a bevy of desktop systems to become available that incorporate CD-ROM drives and utilize the CD-ROM XA standard.

All-digital cameras tout the convenience of not requiring a trip to the film processor. Kodak, for its part, claims as its advantage the tremendous amount of data which it stores for each image. Digital cameras produce images with only as much resolution as today's television sets. Photo CD, however, stores images with 10-times television resolution. This means that Photo CD has the resolution for HDTV (high-definition television) and even sharper display systems. Think of Photo CD, say Kodak executives, as a "digital negative" that can preserve images for display years into the future.

On the computer side, Kodak executives expect Photo CD to have its first applications in desktop publishing, where companies will be able to incorporate color photographs into their layouts like they incorporate drawings today. Other applications range from enabling the use of color photos in computer-generated presentations to allowing creation of a multimedia "catalog" on CD, which could sell products with sound and crisp, full-color photos.

Kodak is promoting the Photo CD file format as de facto computer-industry standard, and already has announced the support of Adobe, Aldus, and other key players. If the company is successful, 35-mm film will be positioned at the forefront of the digital revolution. —*M.R.L.*

1992, consumers will drop their 35-mm rolls off at the local photo lab, and for less than $20 have the images transferred to a CD. The CD can be displayed on a television outfitted with a Kodak or Compact Disc Interactive (CD-I) player–or can be used in computerized desktop publishing or presentation systems that use a CD-ROM drive. (See sidebar.)

"Their goal is to try to keep film alive," says Brenda Landry, an analyst with Morgan Stanley & Co. Kodak executives acknowledge this much, but also maintain that, through the decade, film and the 250 million cameras in the world that use it represent the most effective means of capturing images. The Photo CD image, they note, is far superior to that provided by digital cameras. "For as far out as we can see," says Matteson, "electronic image capture won't be able to compete."

Kodak's consumer photography sector–the driving force behind Photo CD–will be wielding its considerable clout to gain its acceptance in the photography world and among consumers. But in order to make this technology a success in the computer world, Kodak needs software tools and relationships. This is where Interactive comes in. Interactive is providing the link to the computer industry that Kodak hopes will make Photo CD a de facto industry standard.

One of the items with which Interactive is helping is software toolkits. Interactive's Photo CD tools, which are expected to be available in the third quarter of 1991, will allow independent software vendors to select, decompress, zoom, crop, and rotate images from a Photo CD, and then print them. Another set of so-called "color management" products will allow wide-ranging peripherals to display and print consistent color images. All this software will be available in versions that support MS-DOS/Windows 3.0, Macintosh OS, SunOS, and Interactive's 386-based UNIX.

The tools enable developers to quickly incorporate Photo CD into their products, and they will help accelerate Photo CD's industry acceptance,

Photo CD's success depends on how fast the all-digital cameras advance, and on Kodak's on-time delivery of it

explains Ajit Gill, head of Interactive's Imaging and Applications Division. But besides the tool development work, vitally important are the distribution channels and relationships that Interactive has forged with the computer industry. Before the Interactive acquisition, Kodak had no route to the low-end computing market for Photo CD tools and standards, says Gill. Interactive, particularly through its existing standard products business, provides this route.

Whether Photo CD will be successful remains a big question. Much of the success, says Nick Arnett, a multimedia analyst and editor of "Multimedia Computing & Presentations," depends on how fast the all-digital cameras advance–as well as whether Kodak meets its commitment to come out with these products when it said it will. Multimedia products are notorious for being late, he explains. But the installed base of 35-mm cameras is a powerful advantage for Kodak, believes Arnett. "People aren't just going to throw away the cameras they have today," he says.

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Interactive and Kodak executives, naturally, are bullish. Based in part on the new Photo CD products, "We're looking forward to a period of very rapid growth for Interactive," says Dennis M. Peck, Interactive's chief executive. He expects the company to quadruple its annual sales to $250 million in the next three years.

Staying Rooted in UNIX

Despite its new focus, says Peck, Interactive will remain grounded in its traditional UNIX businesses. Interactive currently has between 15 and 20 percent of the worldwide market for packaged UNIX that runs on 386- and 486-based computers, according to market researcher International Data Corp. (The Santa Cruz Operation owns most of the rest.) IDC expects the overall market for Intel-based machines to grow between 45 and 50 percent per year over the next five years. Today, the UNIX 386/486 product represents roughly half of Interactive's sales, according to Peck.

Interactive's consulting, porting, and technology-licensing businesses represent the other half of its business. The company is a major porter to Far Eastern clone makers, who are developing copies of Sun Microsystems' SPARC-based workstations. It also, through its 1989 acquisition of networking developer Lachman Associates, receives licensing fees for products such as Sun Microsystems' Network File System (NFS) and TCP/IP applications.

Interactive and Kodak are bullish. Interactive's chief executive expects quadrupled annual sales in the next three years

But imaging and UNIX application products, which accounted for virtually none of the company's 1990 sales, are clearly the growth area for Interactive. Last year, Interactive began shipping versions of Norton Utilities and Lotus 1-2-3 for UNIX System V. "There will be other similar products–popular DOS and Mac applications–that we will port to UNIX and bring to market," says applications division head Gill. Within several years, imaging and UNIX applications could represent more than half of Interactive's business, says Kodak's White.

And imaging, on UNIX and other popular desktop platforms, is perhaps Interactive's biggest upside of all, say executives. "At some point in time you can expect Interactive to integrate full 35-mm color capability into UNIX [applications]," says Peck. "You're going to see a plethora of applications from us that take advantage of this imaging capability. We think that this is really what is going to separate us from a lot of the other suppliers in the future." ■

Michael R. Leibowitz is a San Francisco-based freelance writer specializing in high technology.

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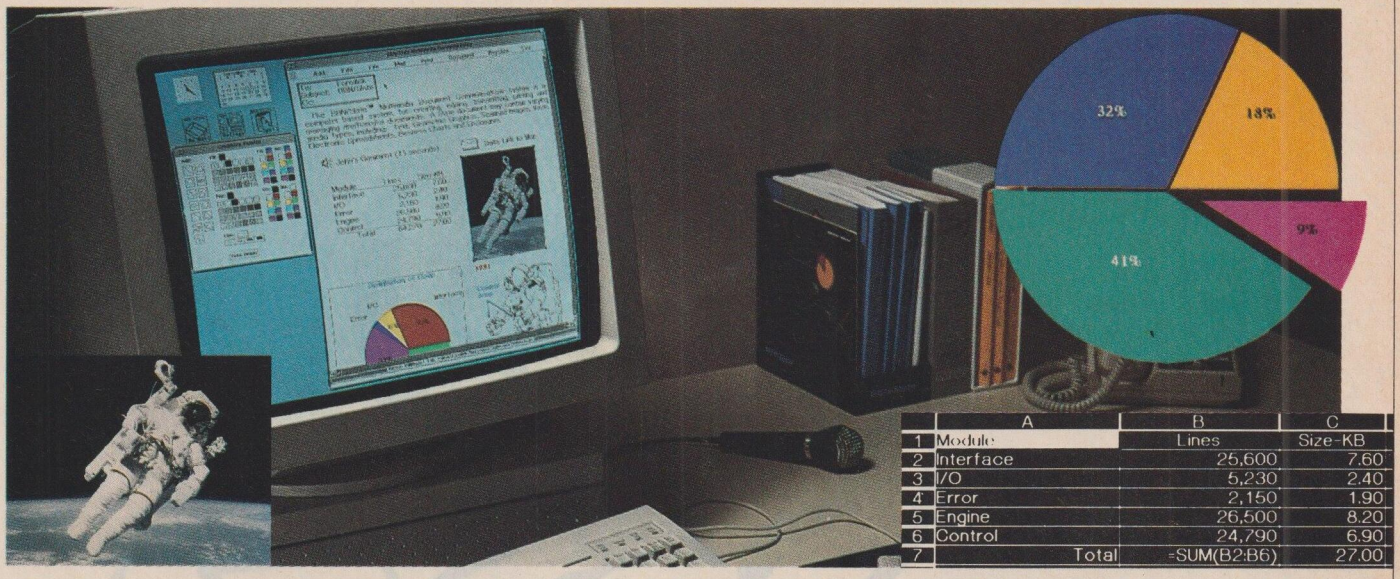

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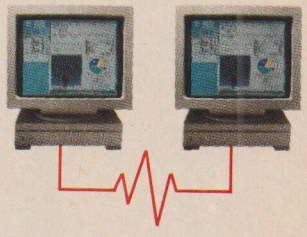

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1991 UNIX World issues will

Open systems is riding a wave of acceptance that is pushing it into the mainstream of the computing world. But its growth, while increasing, is dependent on larger issues. While the 1980s were boom years in computing, the 1990s will be a struggle.

By Gary Andrew Poole

TIM CARROLL

FORECAST

govern its continued growth

Faced with a downturn in the U.S. economy, increasing competition from the Japanese, and the unified countries in Europe, vendors must recognize these issues as reflective of the dependency and competition among world economies. Open systems vendors, predict analysts, must capitalize on the coming economic interdependence of countries if they expect continued proliferation of open systems on a worldwide level. Their success will depend on their ability to capitalize on these world markets.

The open systems movement has not been a single-country phenomenon. UNIX-based systems grew solidly at 27 percent to more than 570,000 units shipped worldwide in 1989, according to Framingham, Mass.-based International Data Corp. (IDC). In 1991 one million UNIX systems will ship worldwide, creating an installed base of over 3.5 million. This growth is solid, but slower than predicted. Most analysts say UNIX will continue its solid growth rate, but as Europe 1992 looms, as Japan becomes stronger, and as the U.S. economy softens, U.S. UNIX vendors must establish themselves in overseas markets or risk profitability.

Vendors Push for Global Prowess

Most UNIX vendors have started this move. UNIX shipments outside the U.S. will grow at a 46 percent rate between 1989 and 1994, while the U.S. market will grow at a 39 percent rate compounded annually, predicts IDC. In other words, the U.S. market will grow, but Europe is the best growth area for hardware and software vendors.

UNIX vendors have expanded their reach in Europe over the last few years. Many vendors have developed distribution channels, manufacturing plants, and sales offices abroad.

Vendors have been preparing for the internationally oriented 1990s, but "confusion reigns," according to Douglas J. Crook, a senior industry analyst with Dataquest, a research firm based in San Jose, Calif. Crook says while customers once wanted products that were "better, faster, cheaper," now customers want open systems. A change to open systems isn't as easy to legitimize as "better, faster, cheaper," although the ends are essentially the same: increased productivity.

Open systems "ultimately benefit everyone," says Rikki Kirzner, also a senior industry analyst with Dataquest, because they promote new technological development, lower the cost of market entry, and increase competition.

The benefits of open systems have made vendors, independent software vendors (ISVs), and users want open systems, but it still contains stumbling blocks. The primary problem comes from vendors, like IBM, Digital Equipment Corp., and Hewlett-Packard, who make more money from proprietary systems. Another stumbling block comes from the overall UNIX market and its leanings toward technical sales. More than half of the value (of UNIX sales) shipped in 1989 went into technical applications, which continues to be UNIX's area of strength, says Maggie Konner, an analyst with IDC.

continued

UNIX's European Stronghold

UNIX is becoming popular in all applications, but it's not a United States-centric operating system. In fact, UNIX finds *more* acceptance in Europe.

UNIX is taking off in Europe more than in the United States, says Julie Rodwin, a senior industry analyst with the Gartner Group. She says as the European countries unify in 1992, bridging systems between countries will become an issue. "Open systems is the logical choice," she says.

Rodwin also sees a need for UNIX vendors to push into Eastern Europe. Although she concedes "Eastern Europe is more worried about food than computers now," she says that vendors need to "put a stake in the ground" and develop a presence in Eastern Europe.

"Eastern Europe and the Soviet Union are going to be gung-ho on UNIX," she says. "European and Japanese vendors are already making a move into these countries. It takes a long-term vision. U.S. vendors need to get in there or they'll lose out."

Jane Doorly, a senior industry analyst with Dataquest, says Eastern Europe is a growth area, but it needs to go through a series of steps before it can possibly think of open systems. She says there's been lots of hype on *immediate* opportunities, but these countries have trouble getting their daily allowance of food. She says telephone lines in the Soviet Union are in only one in eight homes. Computers aren't high on the list of needs at the moment in most Eastern European countries.

Still, she says, the potential is incredible. Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Rumania, and Yugoslavia have a combined population of 136 million. Eastern Europe is a potentially larger market than Japan, based on population size, she says.

The Desktop Blues

In all countries, UNIX needs to penetrate the desktop to be a commercial force, say most analysts.

"In order for UNIX systems to make up a sizeable chunk of the systems market–and IDC forecasts they will account for 21.4 percent–these systems will have to penetrate commercial applications further," says Konner with IDC. "On the desktop, workstations are making inroads into high-end applications like financial trading. Because OS/2 has not been successful to date, there is still a window for UNIX to establish itself as an alternative operating system for demanding applications."

In fact, IDC predicts that in 1994, the UNIX PC market–encompassing workstations as well as personal computers–will account for more than 20 percent of the value of all PC systems shipped worldwide. So why only 20 percent? The reasons are many, but simply stated: companies are enthusiastic about open standards because it's cheaper in the long run, but they're still hooked into MS-DOS because it's cheaper and easier to use.

Acceptance on the desktop is important in the United States, Europe, and Japan, and analysts say it will be commercially accepted in that order. The popularity of Windows has kept many DOS users loyal, and the installed base is enormous. (In 1987 Windows held 2.3 percent of the operating system market, according to IDC. In 1994, it will have 28.7 percent of the market.)

UNIX on the desktop will become popular in Europe, but it will be a smaller overall market than in the United States. In Japan, PCs running UNIX won't catch on until after 1994, says Maggie Konner with IDC, because applications that drive commercial workstations will be written for U.S. customers first. "Despite strong acceptance of UNIX in Europe, poor acceptance in the Japanese market will keep UNIX down to 35.5 percent of shipment outside the United States in 1994, and 30.5 percent of the value shipped," she says.

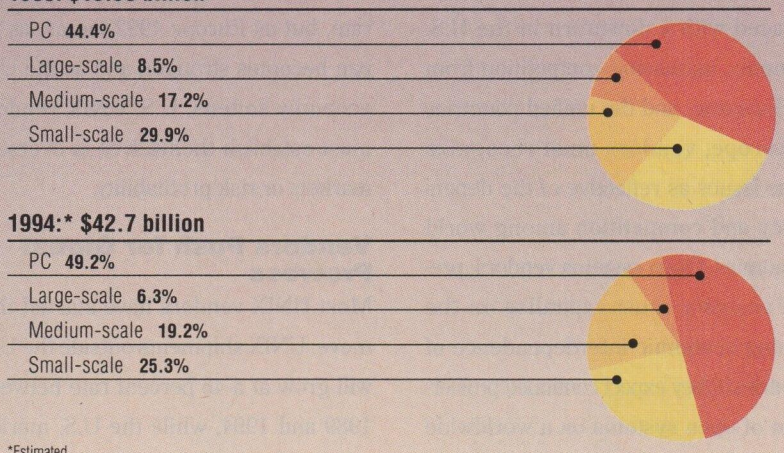
"UNIX growth in Japan is a bit slower," concurs Julie Rodwin with the Gartner Group. "The reason for the slow growth is Japan's lack of a large installed base."

What's Hot?

Workstations continue to be the hottest commodity in the UNIX market; the compound annual growth rate (CAGR) of workstations was 60.2 percent be-

Value of Worldwide UNIX Shipments

IDC predicts that growth will occur in PCs and medium-scale systems, while large- and small-scale system shipments will fall. PCs are defined as single-user systems, workstations, and servers. Small-scale systems typically range from $10,000 to $100,000 and support 2 to 32 users. Medium-scale systems range from $100,000 to $1 million and support 33 to 128 users in a commercial environment. Large-scale systems cost over $1 million and support more than 128 users.



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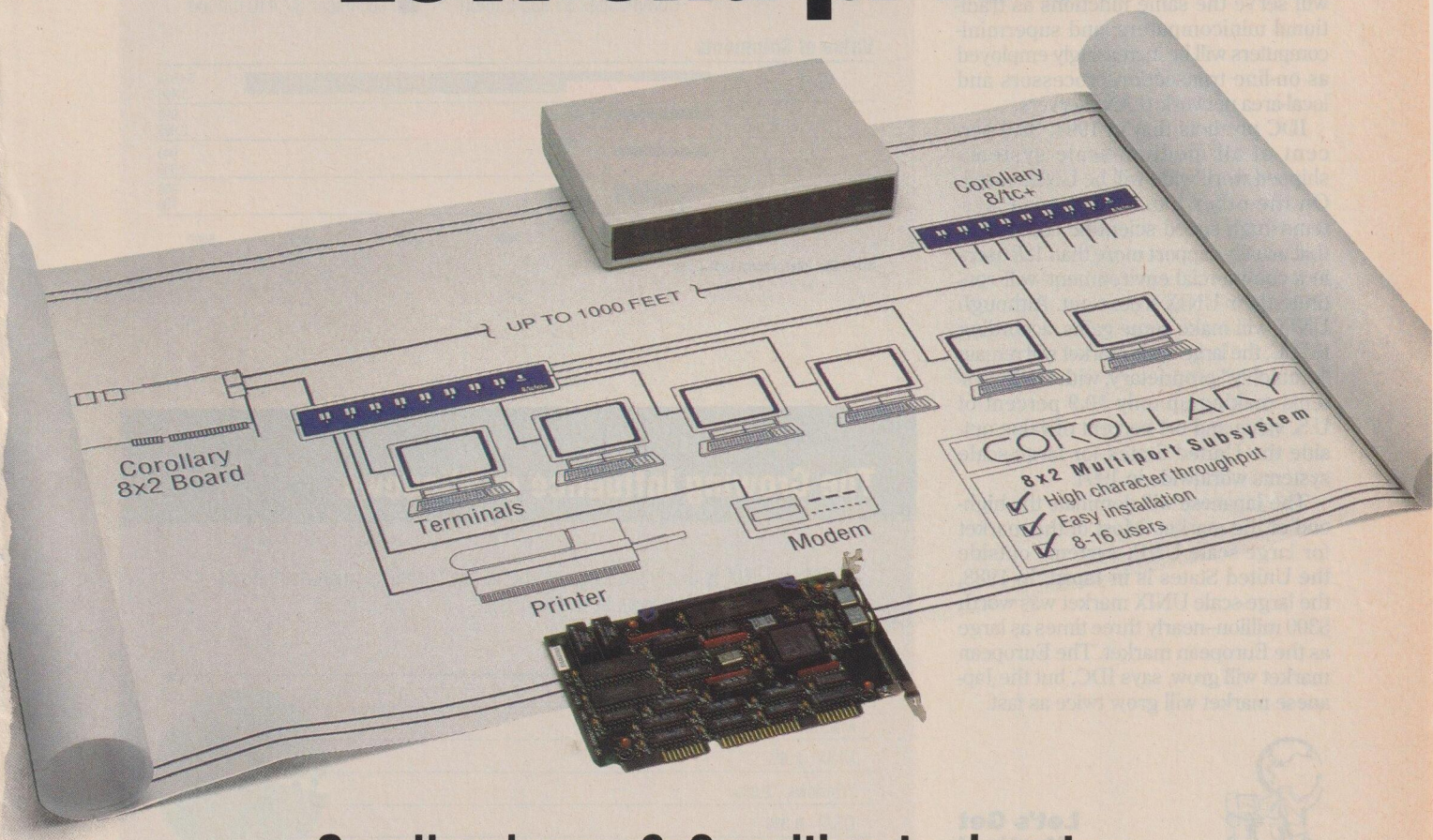

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tween 1985 to 1989, according to Dataquest. Workstations will continue their dominance and are overtaking the midrange–superminis and some small mainframes–but despite this, the "midrange is not dead," says Ken Thornton, manager of Computer and Applications with Dataquest. He says midrange systems are being recast as application servers, database servers, and communications gateways; multiuser multiprocessing, UNIX-based microprocessors will serve the same functions as traditional minicomputers; and superminicomputers will be increasingly employed as on-line transaction processors and local-area network (LAN) servers.

IDC predicts that in 1994, 35.6 percent of all medium-scale systems shipped worldwide will be UNIX-based. On the other hand, large-scale systems–high-speed scientific computers that usually support more than 128 users in a commercial environment–will continue their UNIX freeze-out. Although UNIX will make some gains, according to IDC, the large-scale market will remain "staunchly" proprietary, with UNIX systems making up only 10.9 percent of U.S. value and 6.4 percent of value outside the United States for large-scale systems worldwide in 1994.

The Japanese will dominate the high-end of the market. Most of the market for large-scale UNIX systems outside the United States is in Japan. In 1988, the large-scale UNIX market was worth $300 million–nearly three times as large as the European market. The European market will grow, says IDC, but the Japanese market will grow twice as fast.

Let's Get Vertical

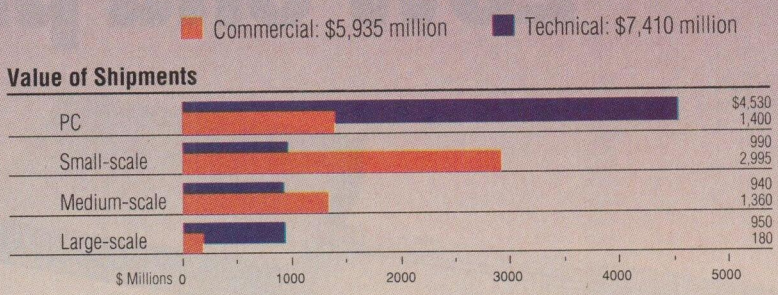
There's little doubt that UNIX is growing in all markets–desktop, midrange, large-scale–and in all developed countries, but which vertical markets are adopting UNIX? And how difficult is it to convince those markets to change to open systems?

The last question might be the most difficult to answer because it's so subjective. The DMR Group, a research group based in Ontario, Canada, did a study recently that concluded that MIS managers haven't been convinced that open systems is the best choice because they don't understand what open systems means. Only six percent of the surveyed establishments consider themselves open systems adopters, yet 24 percent of that sample currently use UNIX.

Despite the confusion, open systems

UNIX Systems Market by Application, 1989

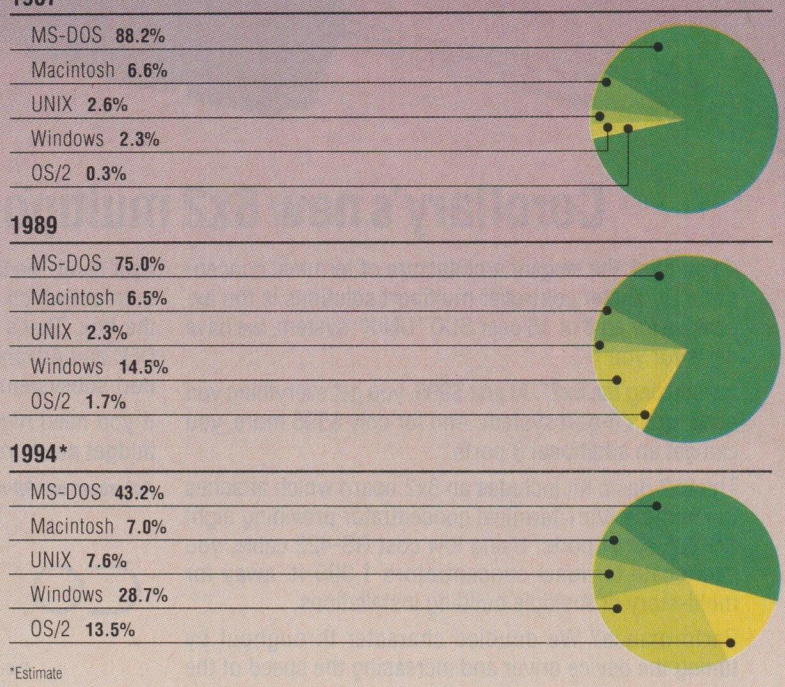
Last year's worldwide value of shipments for UNIX shows that technical applications continue to garner the major share of UNIX applications. According to IDC, this is most true of single-user PCs and workstations.



SOURCE: International Data Corp.

The Growing Influence of Windows

While UNIX is predicted to gain ground, IDC predicts huge market share penetration by Windows from Microsoft.



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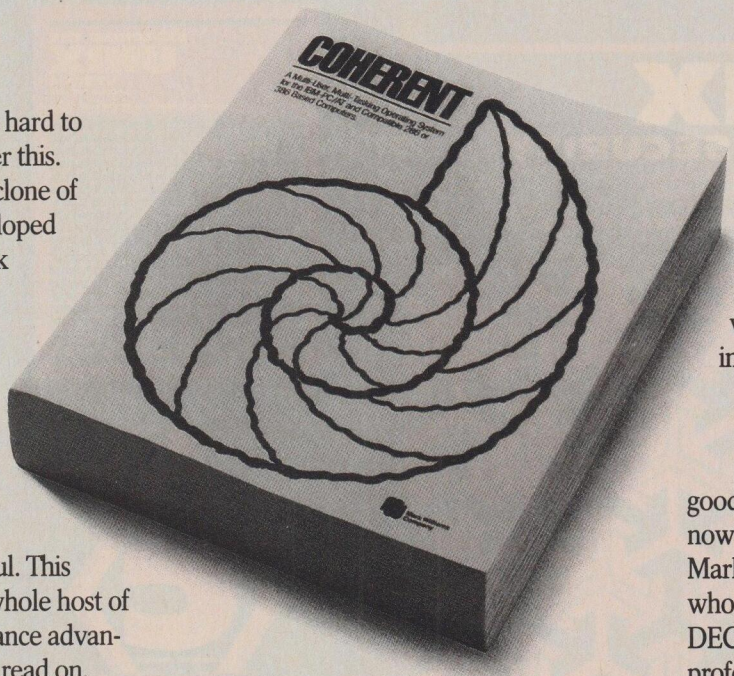

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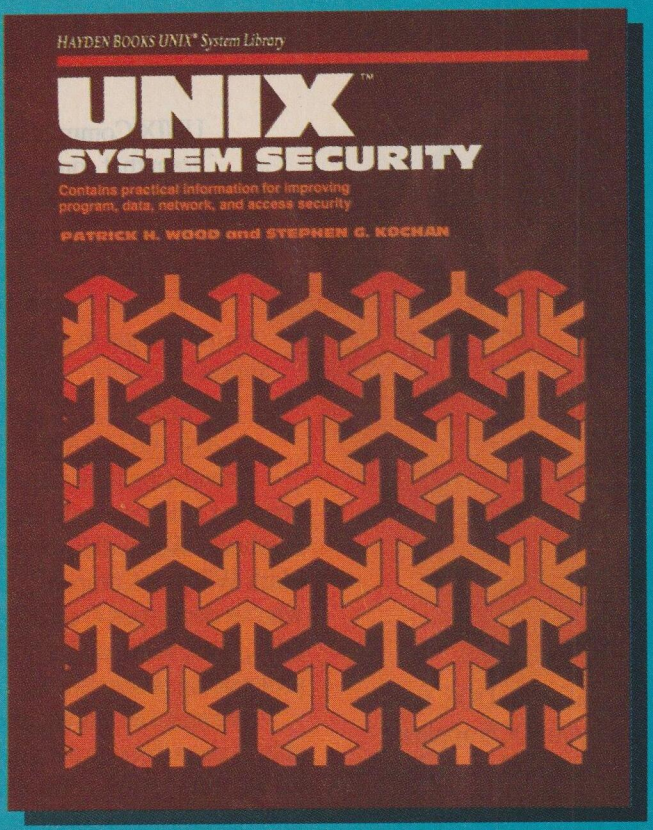

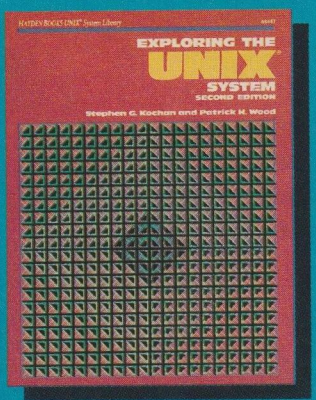

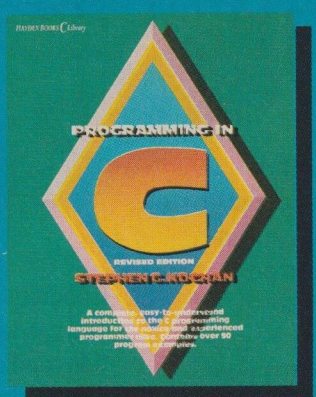

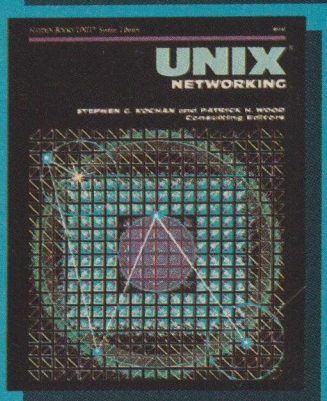

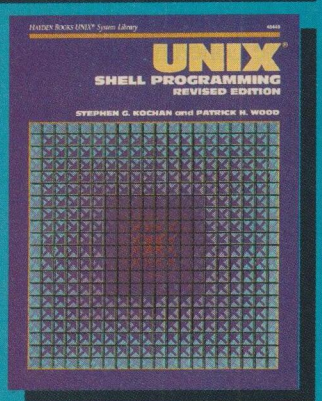

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has made inroads into vertical applications. Two groups, according to DMR, have been early adopters of open systems: the percentage of respondents from the electronic data processing industry that had already adopted open systems was 21 percent, while the federal government was second, at 17 percent.

Individually, UNIX is fairing very well in design automation, which had 33.7 percent of the technical applications market in 1989, according to Dataquest. Another area of coming strength is earth resources, according to Rikki Kirzner with Dataquest. The instability of oil prices has caused many petrochemical companies to take money away from expensive exploration costs and put it into exploring existing sites with graphics and imaging technology, she says.

"It's really an environmental issue," says Kirzner. "As oil prices fluctuate, there's a renewed interest in re-using existing oil sites." She says high-end workstations and superminicomputers are the machines of choice for companies involved in exploration because of their CAD/CAM capabilities. "Companies in earth resources are becoming UNIX-based," she says. "They don't want to become locked into proprietary systems."

Kirzner says the petrochemical industry is the largest growth area in earth resources, but water experts, meteorologists, and other earth resource fields are buying into open systems through high-end workstations and superminis.

"Earth resources was a slow growth area until recently, but now it's extremely popular," she adds. "The number of applications is especially high in the United States because of our need for viable energy resources."

Others agree, but say it will take longer for adoption. "The oil and gas industry is retrenching right now and not buying anything," says Greg Green, a computer specialist with the United States Geological Survey. "The conversion costs are too expensive. These companies don't have the money to spend."

Green says that most companies are staying with proprietary systems like Cray and VAXes, but he says if oil stays above $20 a barrel for an extended period of time there will be a slight shift toward workstations as oil and gas companies make more money and have more money to spend.

1991: An Important Year

European unification, the economic strength of Japan, and the relative weakness of the U.S. economy are three factors that have brought challenges to UNIX vendors. Not only do vendors have to sell to a variety of markets, they must educate and support open systems as an issue if they want it to succeed. UNIX has to hurdle a perception problem that has kept it out of many of the lucrative Fortune 1000 sites. Movement into these sites is critical for open systems acceptance.

Yet UNIX is becoming popular. Vendors are sowing the seeds in international markets by getting a foothold in Europe, Eastern Europe, and Japan. UNIX is not a "religion" anymore, but a business. As a business, vendors must move quickly to establish themselves in these diverse markets or risk long-term profitability. ■

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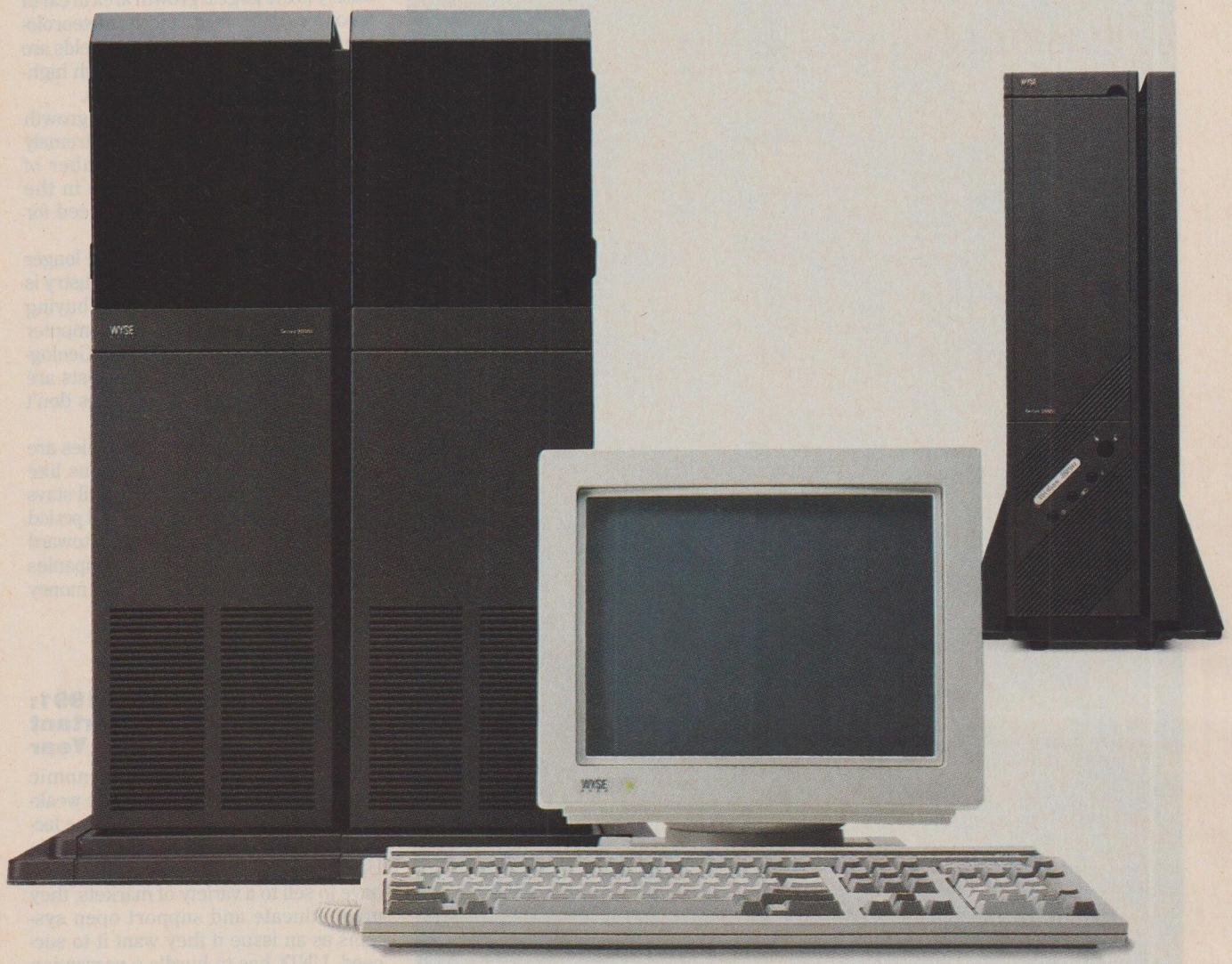

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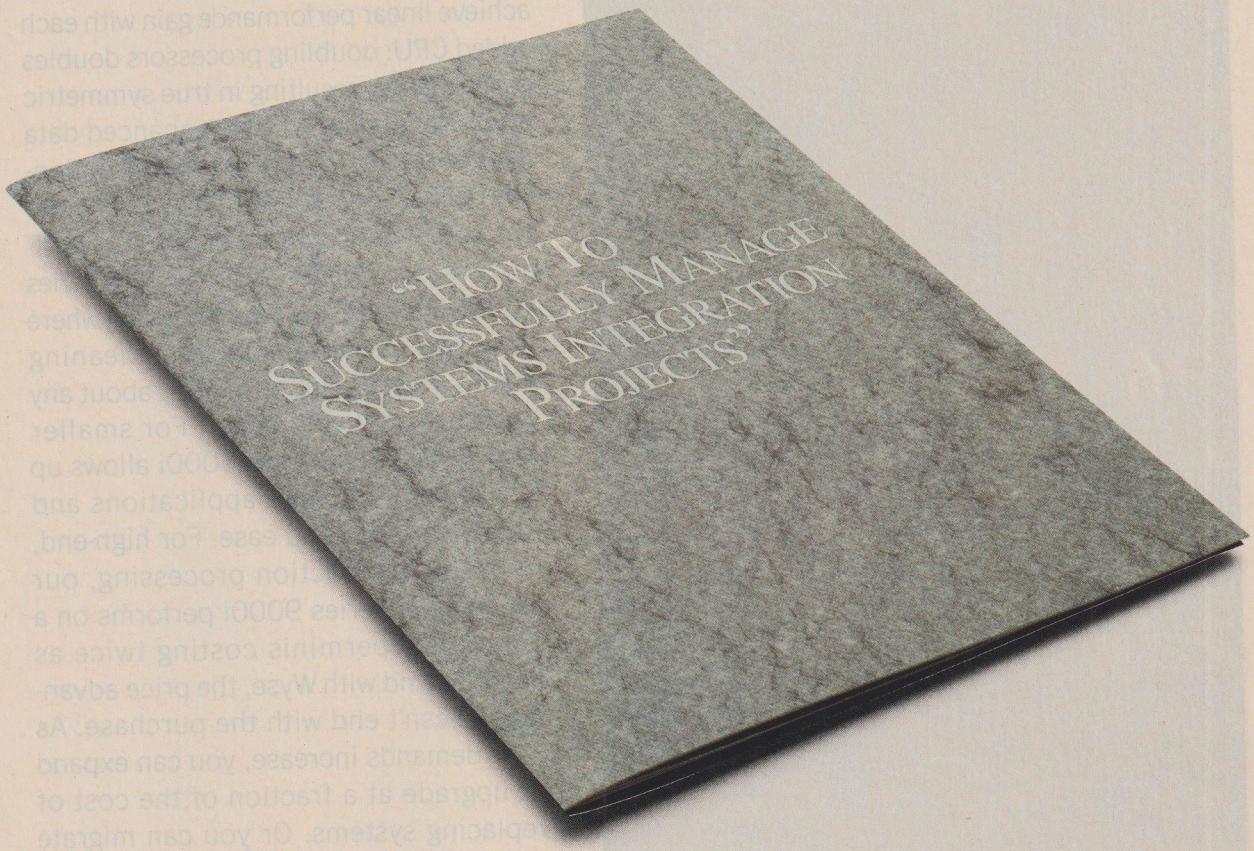

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CIRCLE NO. 240 ON INQUIRY CARD

Integrating Your Office Software

Help in getting your users to order office applications from the same menu

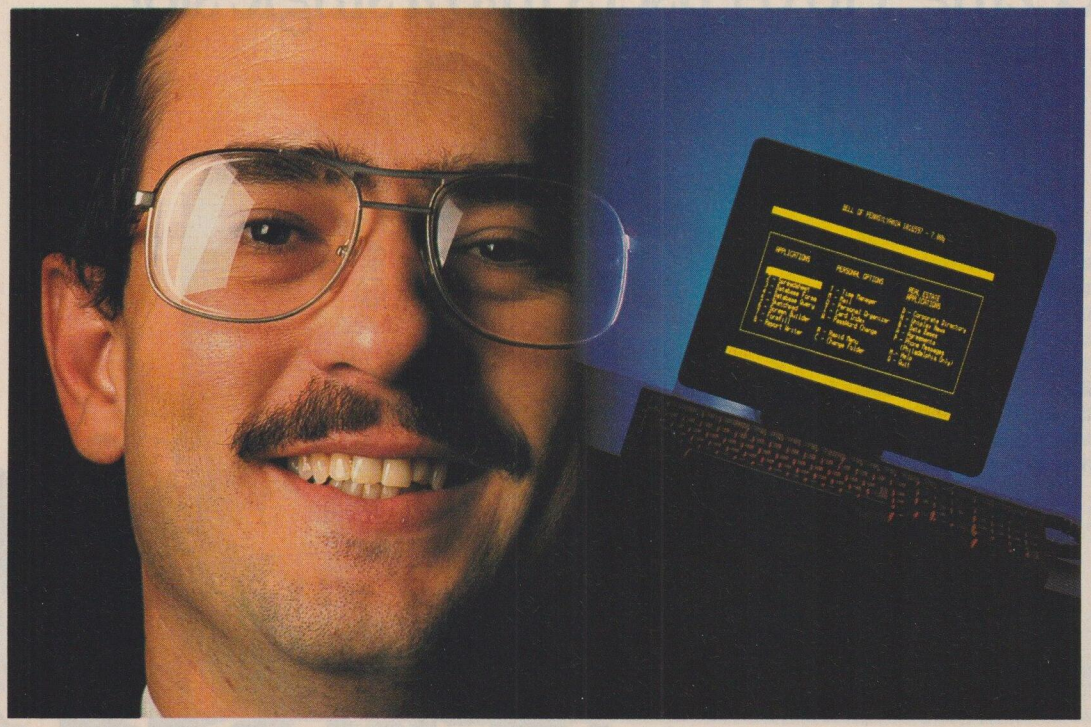
By Howard Baldwin

When Bell Telephone of Pennsylvania's property management group needed an integrated office software (IOS) package, assistant manager for data administration Juan Salcedo set up a careful process. He ordered demonstration packages from four UNIX IOS vendors, and then arranged for himself, his boss, and a secretary to go through the manuals and play with the software. When they were done, the three of them sat down at a conference table and tallied each IOS's pros and cons.

In Salcedo's ultimate choice, Uniplex, he found consistency "very beneficial. It's always **esc q** or F4 to quit, from the mail through the spreadsheets. That simplified training and the understanding of the inexperienced users we were bringing up on-line." And that's the IOS's inherent advantage: once you've learned the basic commands of one module, learning the commands of any other is incrementally easier.

The structure of an IOS is simple: it combines the fundamental applications that you need in an office–word processing, spreadsheet, database, and calendar, among others–underneath a consistent interface and menu.

continued



STEVE BOLJONIS

When selecting an integrated office software package, Juan Salcedo of Bell Telephone of Pennsylvania arranged for software demonstrations for himself, his boss, and a secretary before choosing Uniplex for its consistency between modules.

Are We Compatible?

Today Salcedo's property management group (now part of Bell Atlantic) has four AT&T minicomputers linked between four cities. As with many users, it already had those AT&T computers and needed to find software that ran on that platform. After that, other levels of functionality were required. "The spreadsheet had to be as close to Lotus 1-2-3 as possible, with file conversion from existing files," relates Salcedo, adding that the database had to be compatible with Informix.

There are several levels of compatibility to consider when you're shopping for an IOS. As mentioned, one is the compatibility of commands from module to module. Another is the ability to cut and paste between modules – that is, the ability to take data from one application and insert it into another. Jerry McEachern, technology resources manager for the *Houston Chronicle*, replaced PC XTs with a network of Sun workstations and Visual Technology X terminals, and then requested several demonstration copies before settling on Uniplex. "Our users were not writers and editors, but the secretaries and receptionists who'd had the PCs. [They needed] the ability to pop from one application to another, and to cut and paste."

The same functionality comes into play at the Orange County Superior Court building in Santa Ana, Calif. The judges there use PCs that link via terminal emulation software to a Unisys 6000 server running UNIX, and using QSI's Cliq, they have centralized word processing for communication with the court's secretarial pool.

What helped make the decision for systems manager Will Thacker was Cliq's notepad capability. "Our judges take notes, and it's important for them to be able to develop a limited database where they can retrieve [information] based on a variety of keywords. They need flexibility in the retrieval, and ability to search for [a single word]." If necessary, the data in the notepad can then be transferred into word processing files.

A related compatibility issue are "live links" between modules. When Michael

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Dux Software Corp. 4546 El Camino Real, Suite W, Los Altos, CA 94022; 415-948-1500
QSI 141 Triunfo Canyon Rd., Westlake Village, CA 91361; 805-494-1158
Uniplex 150 W. Carpenter Freeway, Irving, TX 75039; 214-717-0068
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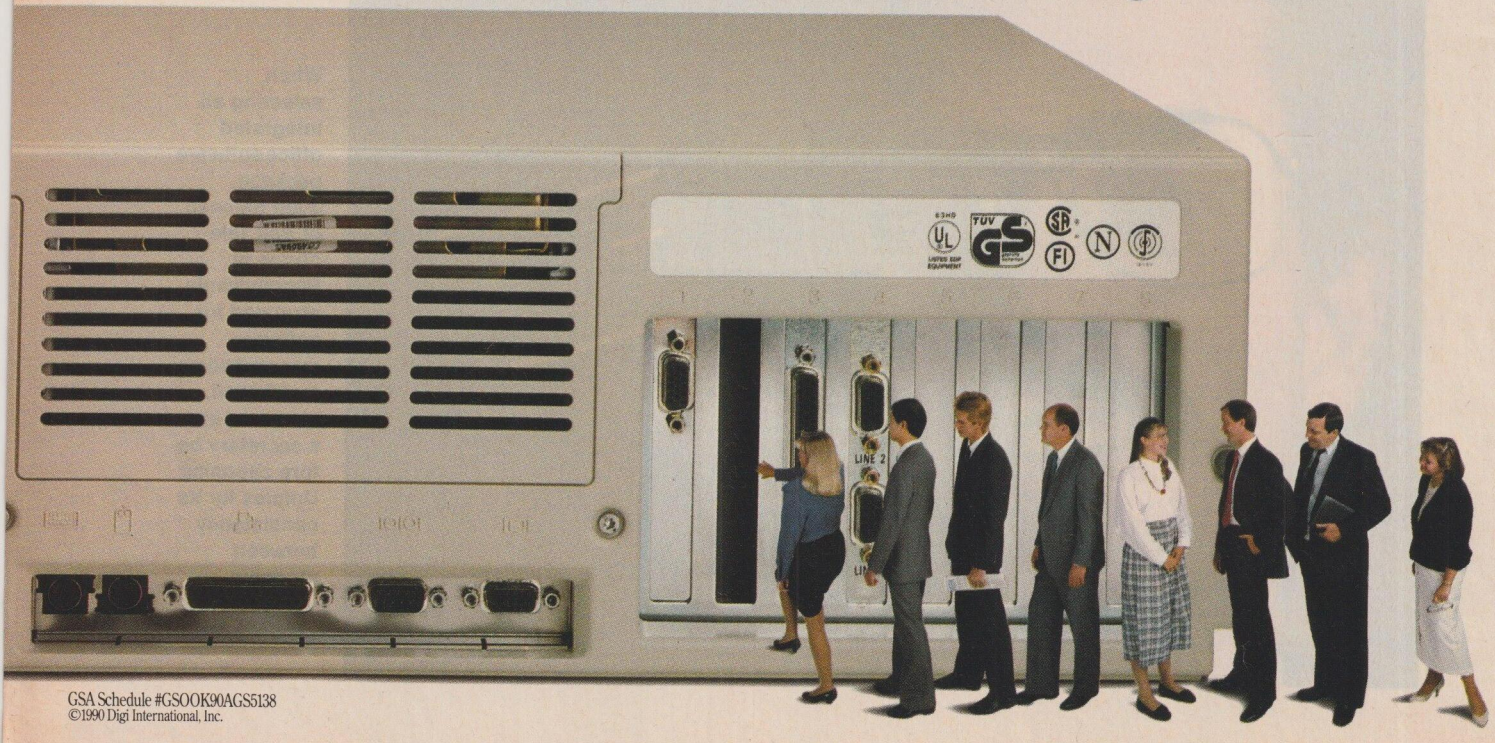

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Lee was in Oracle Software's financial planning and analysis group for U.S. sales (he's now pursuing an MBA at Harvard), he was specifically looking for a product the analysts could use to do enhanced graphics in the spreadsheet, with overlays, boxes, and highlighting, that were similar to those on the Macintosh. His recommendation was for Dux's Quintet IOS, in part because of its ability to have dynamic links between modules, so that when you change information in a spreadsheet file linked to a database file, the latter would be automatically updated.

Still another compatibility issue is the software's ability to link with other software. "There is no product so complete that somebody doesn't want to call up [other software]," insists Anne Lapkin, vice president of Ortech, a systems integrator that uses WordPerfect Office for UNIX in its Manhattan headquarters. "When you call a 'foreign' program, you're not going to get the same function keys and the same look-and-feel, but you need to give people that option within the shell." Lapkin can link to AT&T Mail, Lotus 1-2-3 for UNIX, and Southwind's Tactician accounting software.

In another example, the office of the Australian Bank Industry Ombudsman, the legal arm of the government that enforces bank legislation, needed a system that would follow cases from filing to summation. It is using Applix's Alis integrated with Ingres' 4GL on Sun workstations so that it could use X Windows and ease queries into the information in the cases' legal database.

Thanks For The Memory

While Oracle's Lee recommends certain basic suggestions–such as close looks at demos and talking to other users–the Chronicle's McEachern was concerned about expandability and memory usage. Because of the newspaper's need for expandability, he says, he bought a 512-user site license. "We knew we were going to be installing 300 X terminals, and we didn't want to go back and get [a larger site license]. We want to be able to expand whenever we need to."

McEachern also suggests finding out about memory and CPU usage–is it a hog, and how will it affect performance? McEachern was pleased because the X terminals were running off a host with about 230 gigabytes of data, but the memory usage was very low. "It didn't load in two or three megabytes of data just to do e-mail and word processing," he reports, adding that they've had no problems with X terminal memory resources, one of the drawbacks some users have discovered while using memory-intensive applications under X Windows.

McEachern's points about memory usage and performance are important. The idea of an IOS, after all, is to amortize the time it takes users to learn new software. You don't want to give them something that could make them more efficient, but will also slow them down. ■

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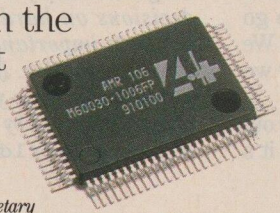

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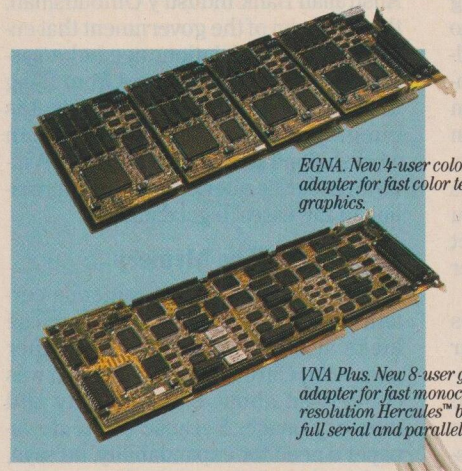

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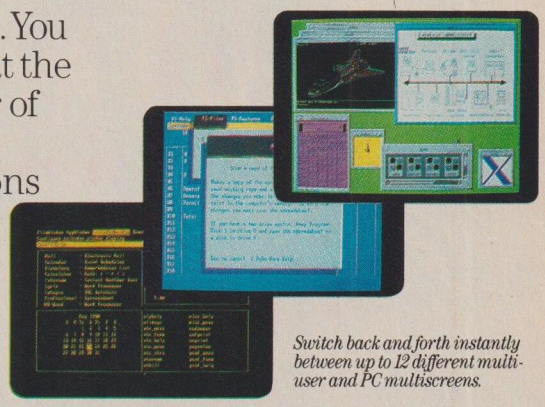

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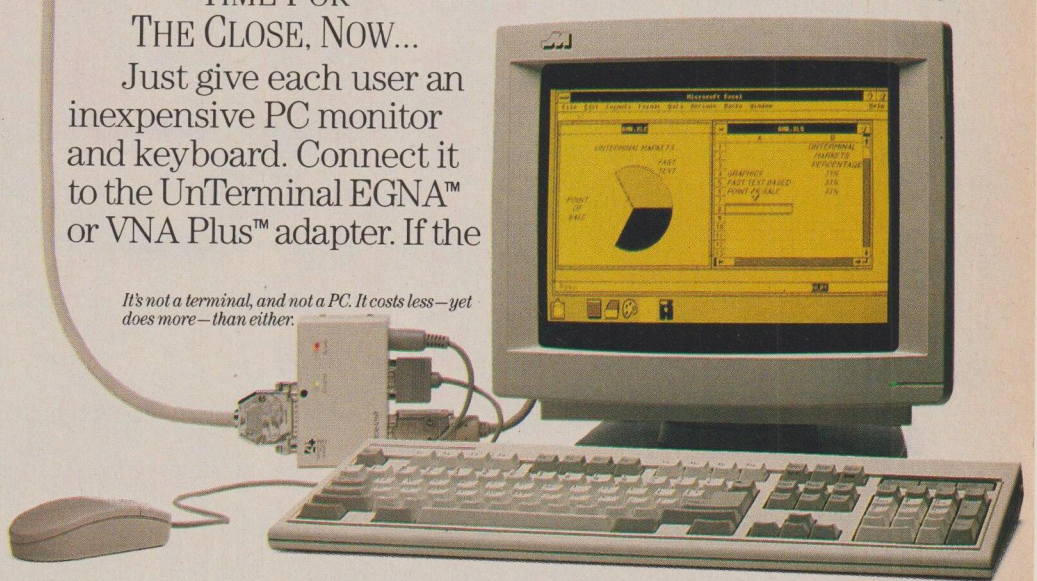

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CIRCLE NO.49 ON INQUIRY CARD

WYSE MUSCLES INTO MULTIPROCESSOR MARKET

You get a lower price for advanced technology, plus symmetry to the eighth power

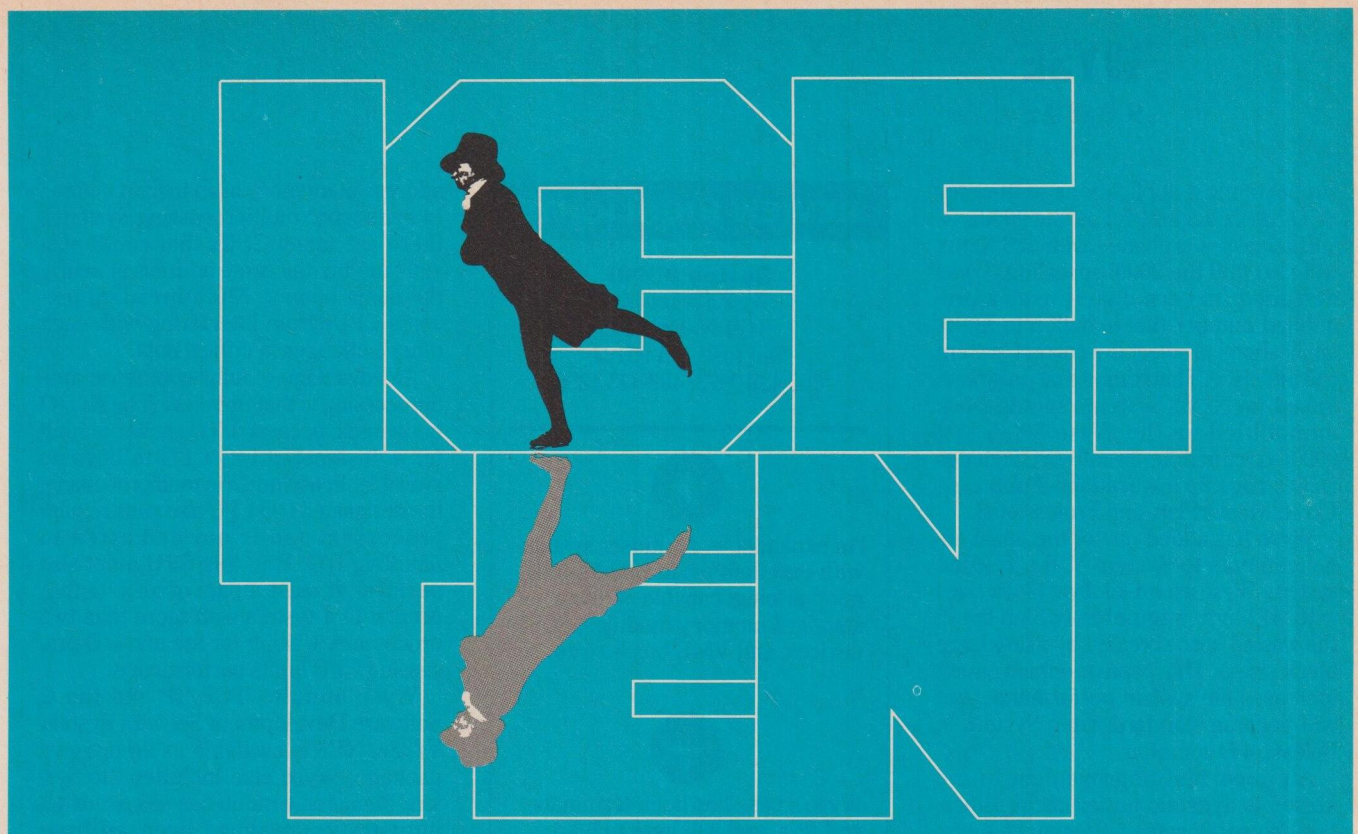
BY RIK FARROW

What happens when a terminal maker enters the mid-size systems market? In the case of Wyse Technology, it has used the Intel 486 chip in its new Series 9000i to make a solid multiprocessor system. The 9000i's price undercuts proprietary minicomputers as well as leading UNIX multiprocessing machines from Sequent and Pyramid. It also adheres to most open system standards.

The 9000i boasts symmetric multiprocessing, supports up to eight 25-MHz 486 processors, and can service more than 200 users. Wyse, quite correctly, is targeting the system at businesses that want to run existing Intel-based applications. The starting price of $74,000 (for a two-processor system) gives you a hint that the 9000i means serious investment. The $184,000 price tag on the six-processor review system makes it clear that the 9000i is a computing solution for an entire company–be it a law firm, hospital, factory, or a large MIS/DP department.

The 9000i operates under System V/386 3.2 (modified for multiprocessing) and runs applications

MARK JOHANN



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supports most applications written for SCO XENIX 2.3 and 2.2 on the 9000i.

Businesses orphaned with 286 XENIX will also find the 9000i appealing. Wyse designed its kernel so it uses a predefined number that is built into XENIX applications to select the correct system call interface. This means that programs linked for XENIX systems should work unmodified on the Wyse 5000i and 9000i. Certified XENIX software includes SCO's flagship applications–FoxBase+, Lyrix, MasterPlan, and Professional.

Wyse has added one of the usual enhancements to System V, the fast file system. Wyse uses 4-kilobyte block sizes with 512-byte fragments (which avoid the wasted space created by using large block sizes). This popular enhancement increases file system performance, but will become standard when System V, Release 4 is common.

An important improvement to the kernel is dynamic buffer cache allocation. Wyse allocates buffer cache memory based on the pattern of memory allocation and disk usage. The dynamic cache allocation permits much larger caches than the default 10 percent, with performance improvements for disk I/O. If memory usage patterns change, cache size can be further increased or decreased. Dynamic buffer allocation makes good use of available memory, and also prevents problems with excess paging–both important features.

Wyse dynamically balances the time slice given to each process. The time slice represents each process' turn using the CPU before the next process takes over. In most UNIX systems, the time slice is fixed at a value somewhere between a quarter of a second and one second. The Wyse kernel varies the time slice between these two values depending on the amount of process activity. This flexibility gives users more processing power when the system is mostly idle, and better response time when it is busy.

REVIEW HIGHLIGHTS

Series 9000i
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An expandable, multiuser system with excellent performance and good pricing; capable of using standard memory modules, SCSI devices, and VME bus boards.

–

Wyse's base has been terminals and PCs, and will have to learn how to provide UNIX system support; too noisy and hot for installation within an office.

Price: *For Model 940 with two 25-MHz 486s, 16 megabytes of RAM, five 200-megabyte disk drives, Ethernet, 32-user license, archive tape and floppy, $74,000. For the reviewed system (64 megabytes of RAM, six 25-MHz 486 CPUs, five 200-megabyte disks, unlimited user licenses, and other standard equipment), $184,000.*
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Symmetry in Silicon

The most important modifications to the Wyse kernel are the changes for fully symmetric multiprocessing. Most UNIX kernels run on a single processor. Other multiprocessing kernels, such as Solbourne's or SCO/Corollary's, set aside one CPU that runs some or all of the I/O. Fully symmetric kernels make no distinction between which processor is running which part of the kernel.

Wyse uses kernel-level multithreading to prevent the actions of one CPU from interfering with another. In a normal kernel, only one CPU is operating, and might be modifying an address in memory at an instant in time. In symmetric multiprocessing systems, there are many CPUs that could possibly modify the same address at nearly the same instant. Multithreading prevents CPUs from interfering with each other's changes in critical data.

An advantage of fully symmetric multiprocessing is that there won't be an I/O bottleneck, because I/O is never waiting for a designated I/O CPU to become available. In asymmetric multiprocessing, the designated I/O CPU also runs regular processes, and is not dedicated to handling I/O. But, this CPU must also perform at least a part of all I/O that occurs. In a system with more than two processors, waiting for the one I/O-processing CPU limits performance.

Wyse bundles TCP/IP and the C Software Development Set with System V/386. NFS is available as an optional package. Wyse also includes the System Manager, a menu-based system administration package licensed from AIM Technologies. The System Manager is a worthwhile product, but don't expect it to turn naive users into system wizards.

Towering Noise Levels

The 9000i tower unit stands a bit taller and wider than many tower configurations. The base unit is 8 inches wide, 21 inches deep, and 28 inches high (plus 2 more inches all around for the UL-approved base). If you add an expansion cabinet, the system grows another eight inches wide. Both the base and the expansion cabinet have four half-height, front-accessible bays behind a door at the top. There is also room for two more half-height drives, but with no outside access. Removing the top cover lets you pop off the sides and get a look inside.

Each tower has a 700-watt power supply running lengthwise about halfway up the cabinet. Wyse recommends that both the base and the expansion cabinet have dedicated 15-amp lines. It's not unreasonable for a system that might support 200 users. No one wants a user blowing a circuit breaker and idling all those people.

Although Wyse says that you can run the 9000i in an open office setting, I disagree. The 9000i, with expansion cabinet, is not deafening, but about as loud as a dishwasher. And with its expansion cabinet, the 9000i produces a noticeable amount of heat (equivalent to about a 1,500-watt space heater). The best place for the 9000i is in an air-conditioned room, devoid of office workers. No raised floor is required.

Below the power supply on the 9000i are eight (base) or six (expansion) proprietary bus slots for CPUs, memory, and optional SCSI Peripheral Adapter. Above the power supply is

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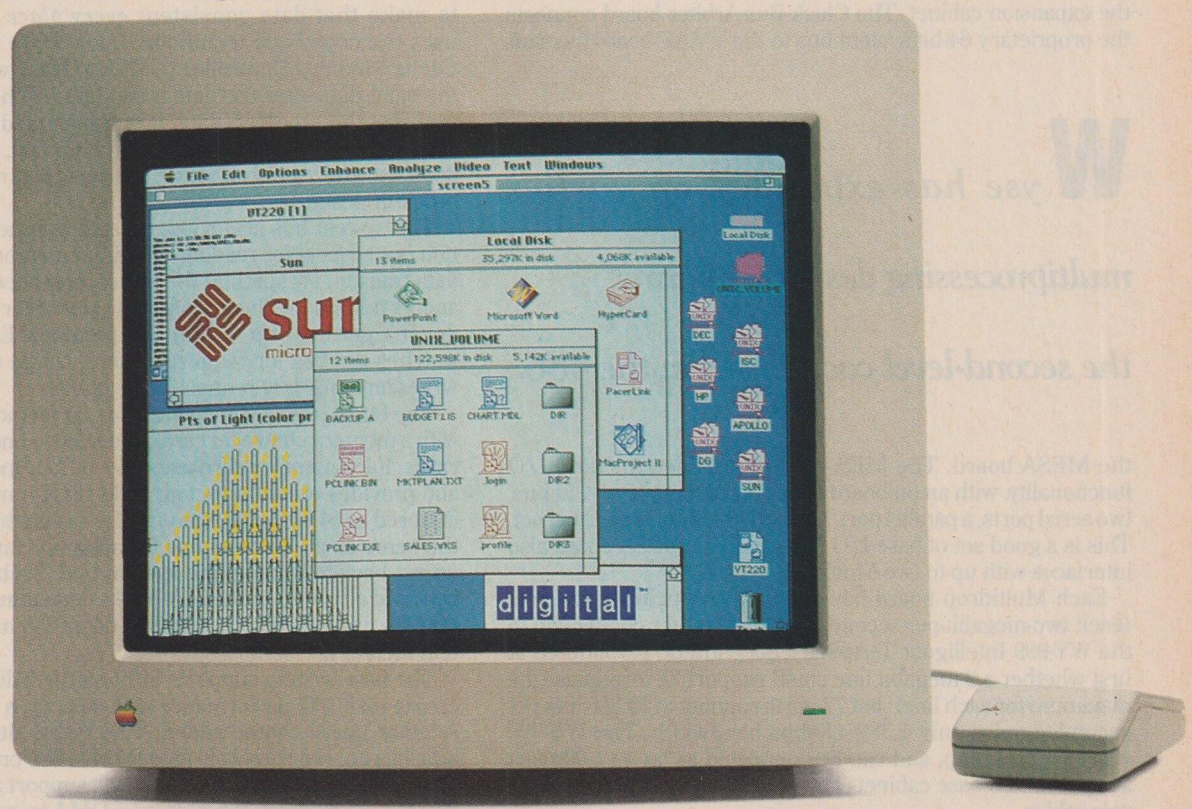

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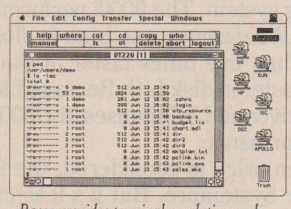

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CIRCLE NO. 192 ON INQUIRY CARD

room for 6U VMEbus cards. The VMEbus requires the Wyse VMAP board for mapping the VME address space to the Wyse proprietary bus. There are 10 VME slots, less one for the VMAP board, available in the two cabinets, providing lots of room for peripheral boards. (By using the VMEbus, Wyse compensates for its non-standard system bus, turning a proprietary system into a more open one.)

The base cabinet has room for several boards not found in the expansion cabinet. The Clock-Bus-Arbiter board connects the proprietary 64-bit system bus to the VMAP board bus and

Wyse has expanded on earlier multiprocessing designs to permit the second-level cache used in the 486

the MESA board. The MESA board provides the core I/O functionality, with an on-board 68000, local memory, SCSI bus, two serial ports, a parallel port, and both thick and thin Ethernet. This is a good set of base I/O features. The MESA board also interfaces with up to two Multidrop boards.

Each Multidrop board has one or two synchronous ports (each two-megabit-per-second RS-422 ports) for connection to the WY-999 Intelligent Terminal Concentrator. I wondered at first whether a 2-megabit line could support 72 terminals (the maximum for each line), but 72 ports running at 19,200 bits per second require only 1,382,400-bps bandwidth. The WY-999 was easy to set up, and can be connected as far as 1,000 feet away from the base cabinet. The RS-422 lines must be twisted-pair cables.

Center Plane Bus

The Wyse 9000i use a proprietary 64-bit system bus running at 10 MHz. That's 8 bytes times 10 million times a second, for a theoretical maximum of 80 megabytes per second. Wyse claims a sustained throughput of 53.2 megabytes per second on its bus, making it 60 percent faster than the enhanced Micro-Channel used in the IBM RS/6000.

The system bus sits on a center plane, instead of the usual back plane found in larger systems. Before setting up the system, I wondered how the system buses in the base and expansion cabinet would be connected. It turns out that they are the same bus. The center plane bus has connectors on both sides, one side in the base cabinet, and the other in the expansion cabinet. The expansion side is covered when not in use.

Each board communicates with the system bus through two interfaces. The SLIC (Serial Link and Interrupt Controller) provides a backdoor for inter-processor communication. Two VLSI chips, the BDP (Bus Data Path) and the BIC (Bus Interface Controller) are present on all system bus boards, handling buffer of data and bus control logic.

Wyse has expanded on earlier multiprocessing designs to permit the second-level cache used in the 486 architecture. The 486 chip has an integrated 80387 math co-processor, memory and cache controller, and 8 kilobytes of no-wait-state cache. The internal chip cache forms the first-level cache. Each CPU board has an additional 128 kilobytes of two-way, set-associative RAM. Wyse has determined how to keep the 486's cache consistent with external cache and system memory.

In a multiprocessor system with memory on-board each CPU, multiple copies of the same data are stored in different places. If a CPU modifies any data, something must be done to make that data consistent *every place* it exists. Wyse uses the copy back technique. Each Wyse CPU card has a Cache Memory Controller (CMC) to track which CPU owns the valid data after the data is modified. When another CPU requires the modified data, it is transferred across the bus. Although copy back systems are complex, this complexity does not affect programming or users, and results in a more efficient design.

The system bus also supports split transactions. A transaction is a request for reading or writing memory and the actual data transfer. By splitting the transaction between the request and its fulfillment, the system bus runs faster because the bus doesn't get held up waiting for memory. Each CPU board watches the bus for requests. There can be three reads, two writes, and one I/O request in the queue.

The 9000i uses a somewhat unusual memory organization, with a memory controller card connected to one or two memory cards. Each memory card uses one- or four-megabyte SIMMs, and provides error-correcting code (ECC) memory. Memory is stored as 64 bits wide (same as the system bus), and 128 bits, the same as a CPU secondary cache line, and can be transferred back-to-back on the system bus. Each memory board can hold either 16 or 64 megabytes, depending on the types of SIMMs used, for a total of either 64 or 256 megabytes of system memory.

The base system supports SCSI on the MESA board. To increase disk I/O performance and capacity, a SCSI Peripheral Adapter board can be added. This board sits on the system bus, has its own zero-wait-state RAM, a 386 processor, and two synchronous SCSI channels that will support a total of 14 SCSI devices. Each channel has its own DMA to system memory.

Fast Benchmarking Results

The Wyse 9000i does exceptionally well in the UNIXWORLD/Neal Nelson Benchmarks. Notice that each test starts out nearly level, and then slowly increases in total time as more users become active. This initial-level performance shows how well Wyse has implemented the symmetric multiprocessing system. The 9000i performed three times faster than the ALR reference machine in floating-point performance, more than five times faster in the calculation tests, and 10 times faster in disk I/O. Because files were distributed across both drives and SCSI buses, the 9000i definitely gains an edge in performance.

When price is considered, the 9000i costs more than an ALR or Systempro. But it's less expensive than a similarly equipped Sequent S27. Wyse has good marketing channels through VARs and distributors, which should help it make inroads in the UNIX multiuser and database server markets. In a nutshell, if Wyse can provide high-level service and support for UNIX, it has a winner. ■

Rik Farrow is a software engineer, and author of a book on UNIX system security. He teaches courses on system administration and system security.

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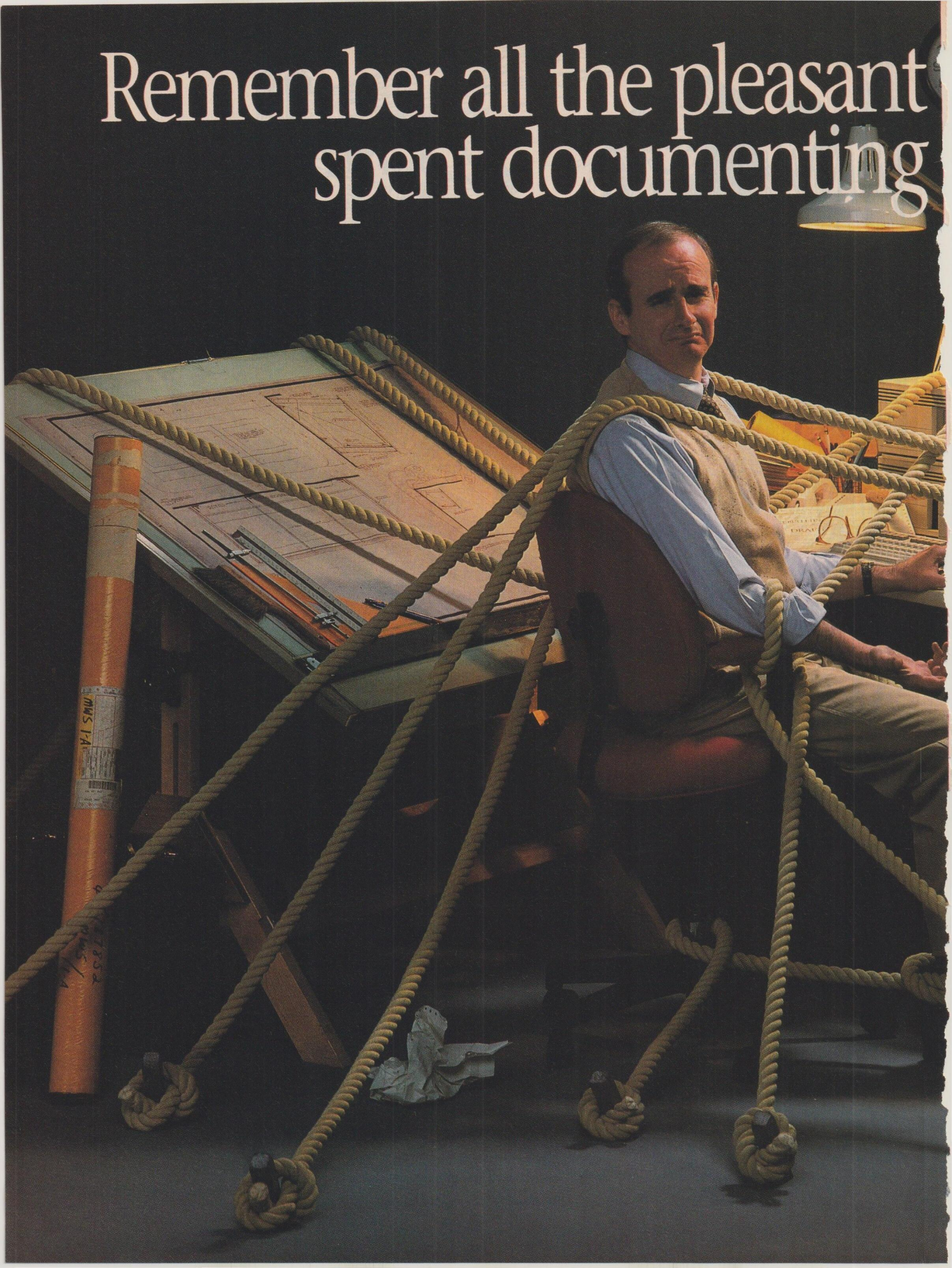

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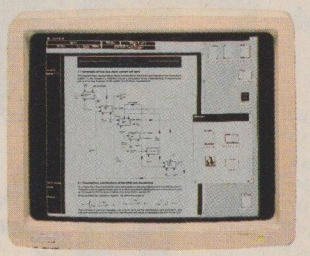

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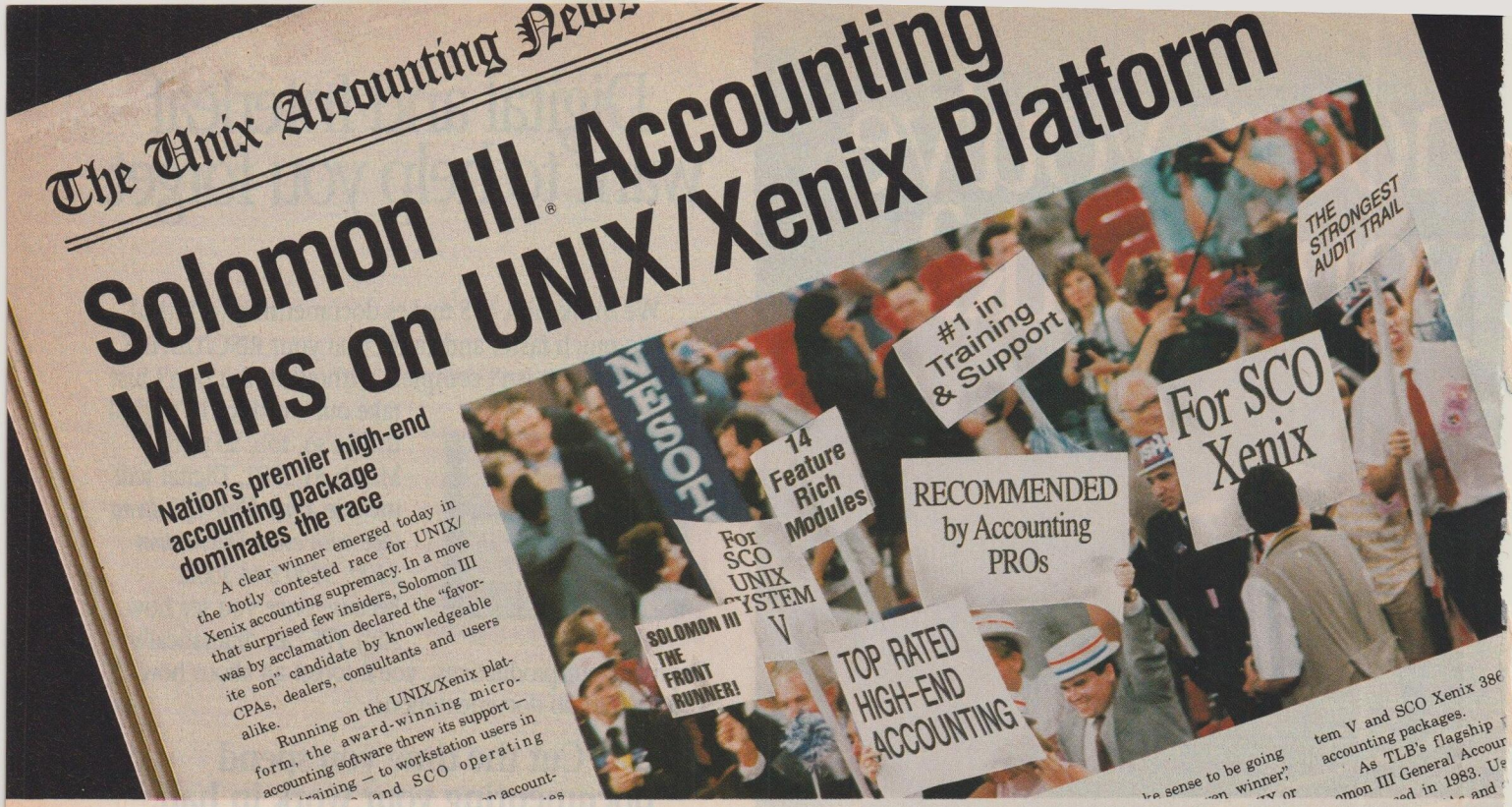

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CIRCLE NO. 238 ON INQUIRY CARD

TOOLS FOR FLEXIBLE INTERFACE DESIGN

By Rick Farris

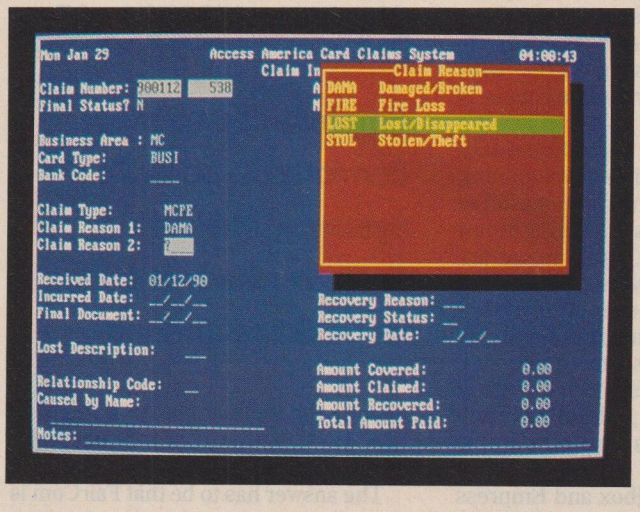
Two affordable 4GLs make database application development easier

If you develop database applications, you've probably wished for a tool to automate the repetitive parts of your job. Wish fulfillment comes in the form of 4GL application generators, but finding the right one can be hit-or-miss. Two products for the 3GL-savvy market–namely, Empress 4GL and the FairCom Toolbox–offer screen handling and database interface tools, without forcing you into someone else's look and feel.

An application generator is a standalone program that churns out code for a companion DBMS product. Many application generators require you to squeeze your application into the narrow mold of pre-defined structures. For instance, menus might always appear in vertical format, or data-input screens might always be centered on the screen. To many programmers, this is intolerable, so this review focuses on two products that offer flexible interface design–at a price affordable to most businesses.

Both Empress 4GL and FairCom Toolbox require a C-language development system to be installed on your computer. And although they advertise themselves as 4GLs, each requires you to write procedural code in C even for the simplest applications. On the other hand, both are capable of developing most any application, including BLOB (Binary Large Object–sound and/or video) storage and retrieval. But in a nutshell, these are programmers' products, and not truly suitable for end users who want to develop or modify applications.

The base Empress system, plus 4GL, sells for $4,200 in its SCO UNIX version. It is suitable for large projects, especially ones involving many programmers. Empress' high-level tools and documentation mean that less effort has to be expended documenting in-house development tools. The FairCom Toolbox's major strength is it comes with complete C source code (its code generator ex-



The FairCom Toolbox (top) and Empress 4GL (bottom) provide database application developers with the capability to create flexible interfaces for any kind of application, including BLOB storage and retrieval.

What is a 4GL, anyway?

Defining a fourth-generation language has become a religious issue. One camp says that the amount of work done by each individual programming statement determines whether the language is 4GL or 3GL. Hence, they claim that dBase is a 4GL because each of its statements is equivalent to several dozens of statements in C.

The other camp says that a 4GL is non-procedural (NPL). An example is a database application generator where the programmer paints an input screen and a report screen and the application generator takes care of the details: creation of the database, input and output routines, and maintenance. A much more confusing example is a traditional non-procedural language like Prolog. If you've ever investigated one of these, you know how foreign the concept of goal-oriented programming is at first.

The thread between both examples, though, is that the programmer specifies the results, and not the steps to take to achieve the results. That's why they are called non-procedural languages, and that's what makes them 4GLs.

Many 4GLs are easy enough for end users to use, but some (like the two we're looking at this month) are oriented toward expert practitioners, and allow them to produce large and/or complicated applications with much less effort than would be necessary with a traditional 3GL like C or Cobol. —*R.F.*

emplifies a program created with the Toolbox). Because source code is supplied, the Toolbox is easy to port to any platform that supports a C compiler. The Toolbox is most suited for projects written by a small team of programmers. Toolbox sells for $1,095 with source code, and no run-time license is required.

Empress presents a traditional 4GL approach to application development, with an integrated environment full of fill-in screens and structured menu entry. The Toolbox, as its name implies, consists of a variety of library routines and a few executables that are used one-at-a-time to build an application. Empress seems most comfortable on UNIX systems (with a workstations slant), while the Toolbox clearly shows its DOS background.

The FairCom Toolbox and Empress are relative newcomers to the 4GL market. And, because of their 3GL slant, they are more likely to turn up behind-the-scenes in vertical applications, rather than being pushed as end-user tools. Also, the largest 4GL vendors have often been "adopted" by another manufacturer. For instance, Ingres is bundled with SCO Open Desktop, and Progress is a standard NCR offering.

Both products were reviewed on a 386-based system under SCO UNIX. Neither Empress nor the Toolbox utilize SCO's **custom** installation program. Even so, both products installed smoothly.

The FairCom Toolbox

I was suspicious of the FairCom Toolbox when I began the review. Why, I wondered, would a professional vendor ship its product in DOS format? True, the **doscp** utility makes it easy enough to copy the toolbox files to a XENIX or SCO UNIX system, but why not make proper diskettes?

Empress seems most comfortable on UNIX systems, while the Toolbox clearly shows its DOS background

The answer has to be that FairCom is a small company and not pretentious about its product. If you can use **doscp**, there is no need to take on the business overhead of transferring the toolbox to UNIX format. This is a testament to the toolbox's natural portability, which was verified once I arranged the toolbox files in a directory hierarchy and successfully ran **make** to compile and link all the tools.

As its name implies, the Toolbox is a "function library" of application-oriented procedures. Functions are provided for screen handling, database definition, file handling, reporting, data management, and help processing. FairCom believes that no application generator can serve all possible application domains, so they provide you with the tools to build your own specialized application generators. As examples, they provide the C source code to **run** and **catalog**, file-maintenance, and data dictionary application generators, respectively.

Quick and dirty prototypes are developed with the **run** program. You use your favorite text editor to design an input screen. Fields are marked with underscores, background text is typed as desired, and special characters are used to mark box-corners and to indicate where the date and time should be displayed.

The **run** program reads this text file and immediately allows data entry into the database (which it creates), and provides query and reporting facilities. You can use this prototype to refine your database structure and to use as a demonstration tool for customer feedback.

In addition to running the prototype, the **run** program generates a script file that includes default field information and the screens and report formats that it creates for you. You then modify this script file to add field input/output attributes and edits.

After you are happy with your design, the **catalog** program is used to process the script file into a C program, ready for compilation. The **catalog** program also provides a central data dictionary and other tools for the creation of multifile applications.

C Programmers Only?

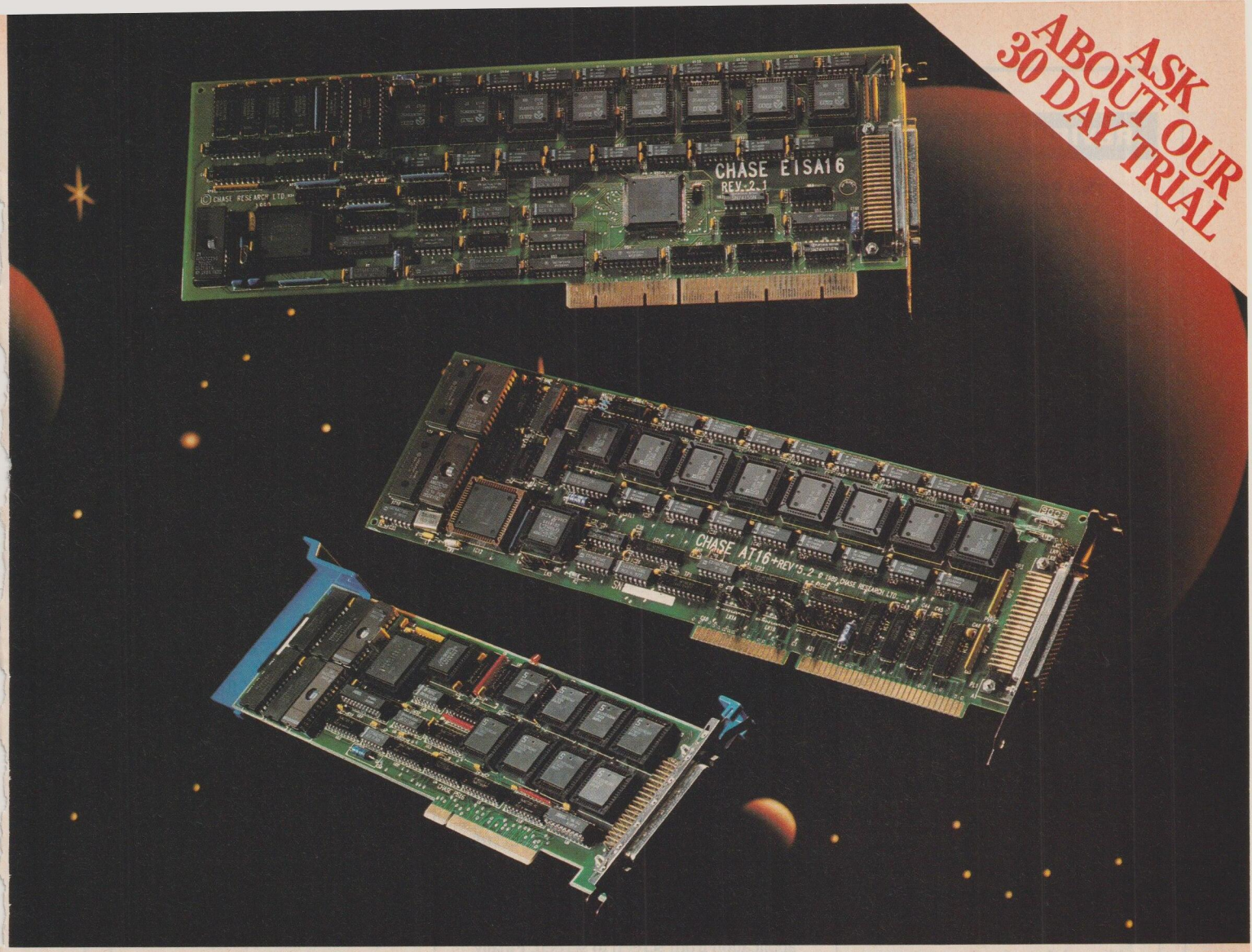
The answer here is an unqualified "yes." Although simple applications could be developed by someone with no C programming experience, there are better products for such users. filePro+ (see UNIXWORLD, April 1990) would be a more suitable candidate for non-programmers.

For dedicated C hackers the Toolbox can be a tremendous productivity enhancement, but even master programmers will need to plan on spending a lot of time with the manuals.

General-purpose 4GLs are quite complex programs, and FairCom provides the tools to build your own. The price you pay is that, in order to move beyond **run** and **catalog**, you must understand how to construct a 4GL. The Toolbox provides examples and documentation, but there is no substitute for experience.

Installing Empress

Do you lie awake at night figuring out how to transform your databases into 4th normal form? Do you think in terms of tuples and attributes instead of rows



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REVIEW HIGHLIGHTS

The FairCom Toolbox
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800-234-8180; 314-445-6833

Complete, portable C source code is supplied. No run-time licensing is necessary. Many example programs are included. Great price.

Requires expert knowledge of C. Much conventional 3GL programming is necessary.

Version: *3.1, Release f02.*
Systems: *Source - any with a C compiler. Binary - DOS, XENIX, OS/2.*
Licensing: *Per programmer.*
Price: *for source, $1,095; for binary, $695.*
Support: *10 a.m. to 6 p.m. (EST). Non-toll-free number. BBS available 24 hours for notes and bug fixes.*
Warranty: *Software is warranted to operate substantially as described, without defects, for six months.*

and columns? If so, Empress might help you sleep more fitfully.

When I opened the Empress package, I was surprised to find just four 1.2-megabyte diskettes. Empress is not compressed; nevertheless, once installed, it managed to consume 15 megabytes of my file system. This happened because Empress is supplied as a set of library files and shell scripts that expand during the installation.

The installation script looks at the coded serial number that you enter, determines your subset of the Empress product line, and builds the appropriate libraries. I like this approach, because it allows you to add another product (say, the report writer or the Fortran interface), and all you have to do is enter another serial number and rerun the installation script.

After creating an empty database with the `emp4glinit` program, I ran the `empsql` program to create the tables and indexes for my application. `empsql` is Empress' interactive SQL facility. A familiarity with SQL is a prerequisite for the use of this product.

Once I created and initialized the database, I used `emp4gl` to draw the screens and menus for the application. I had to write script files (in Empress' proprietary 4GL) to assign a correspondence between screen fields and database fields for each screen.

Surprisingly, although Empress provides a "bulk" data type that can be used to store variable-length binary data, it has few built-in field validations. For instance, to build a telephone number field of the form "(800)555-1212", the

If you like programming in C, the FairCom Toolbox is for you

manual suggests creating three separate input fields and then joining them before storing them in the database.

To its credit, Empress makes it easy to verify that input data is within a range, or that it exists in a table. Again, however, to go beyond an error message and a beep (for instance, to open a window with a list of valid entries to select from) requires writing an error handling routine.

Next, I "glued" the screens together–again with Empress' proprietary 4GL–and wrote a top-level script to guide the application from screen to screen. Finally I compiled and linked the application. This compiling and linking is an internal Empress action–a run-time program is still necessary to execute the application.

Is Empress for Everyone?

Empress is clearly not for everyone. The manuals are full of relational jargon; if you're not familiar with SQL and relational database theory, you will need to spend some time studying at the library before you begin reading the Empress documentation. Empress makes no attempt to teach database theory in its manuals.

On the other hand, if you are already familiar with relational terminology and would like to put your knowledge to use, Empress will appeal to you. It is quite good at dealing with binary data and with forms that are larger than the screen.

Which is Best?

Neither of these products is suitable for a non-programmer, but that doesn't mean that either one is suited for all kinds of programmers.

If you are comfortable in C and like the idea of doing large parts of your development in that language, the FairCom Toolbox is for you. Likewise, if you are building a mass-market product and would rather not pay run-time fees, FairCom would be a good choice.

Consider Empress if you already know SQL, or if you would like your learning investment to be applicable in other environments–many products offer SQL interfaces. Also, because Empress offers a more structured development environment, it may be easier to use for multiprogrammer projects. ■

REVIEW HIGHLIGHTS

Empress 4GL
Empress Software, Inc.
6401 Golden Triangle Dr.
Greenbelt, MD 20770
301-220-1919

Convenient handling of forms that are larger than their windows. Built-in "bulk" datatype for dealing with binary data. Very competent technical support.

All the tools are in place, but there is still a lot of work to do to build a medium-complexity application. Requires learning of Empress proprietary 4GL. Prior knowledge of SQL is also necessary.

Version: *4.3.*
Systems: *386 UNIX and XENIX, Amdahl, Apollo, AT&T, Concurrent, Cray, DG, DEC, HP, IBM RS/6000, Intergraph, MIPS, NCR, Pyramid, Sequent, Silicon Graphics, Sony, Sun, and others. Also available for DOS and Apple systems.*
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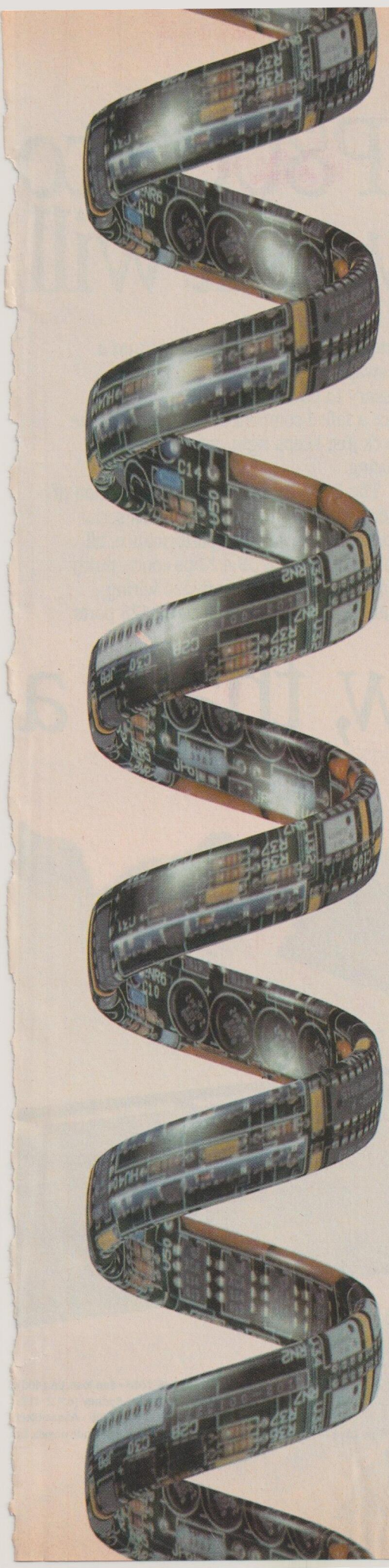
Warranty: *None.*

Rick Farris is a freelance writer and software designer working with high-tech firms in and around San Diego. He can be reached on the Internet as `rfarris@rfengr.com`.



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CIRCLE NO. 245 ON INQUIRY CARD

TWO GOOEY BUILDERS THAT STICK

By Steven Mikes

In a packed field of products, those from Visual Edge and Sun are most popular. Here's why.

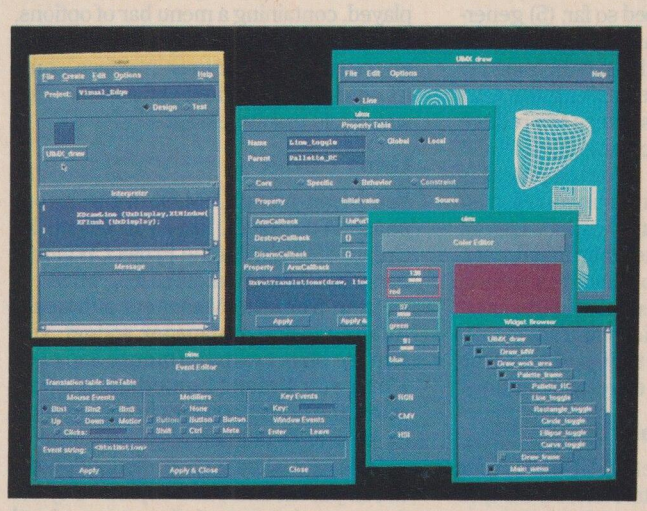
To an X Window System programmer, a graphical user interface (GUI, pronounced gooey) builder is akin to a carpenter's power hammer. No carpenter would drive nails into a house frame with an old-fashioned hammer. By the same token, no X programmer wants to piece together interface windows and buttons all day long.

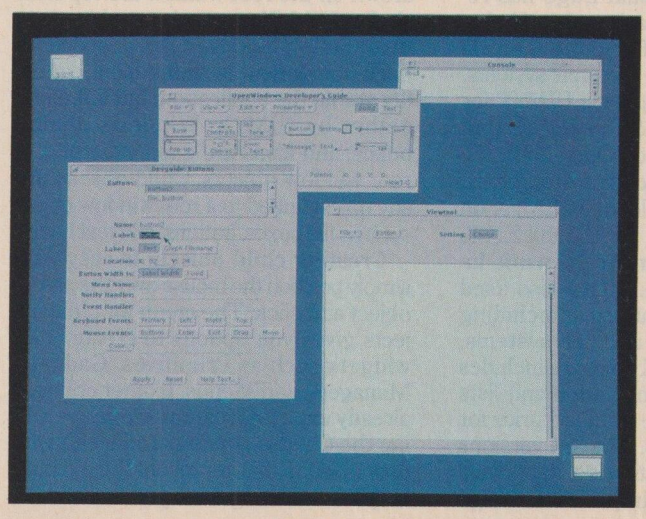
Enter the GUI hammer. In particular, enter UIM/X from Visual Edge and OpenWindows Developer's Guide from Sun Microsystems. These two products, more than any of the 12 or so other GUI builders available for X, have become standards by which others are measured. This does not necessarily mean they are better than some other systems, such as Teleuse from TeleSoft (San Diego, Calif.) or FaceMaker from Non-Standard Logics (Paris, France), but they are definitely touchstones for X programmers.

GUI builders, also known as user interface management system (UIMS) tools, yield quality X applications much faster than the traditional method of coding in a text editor and cycling through compilation, testing, and debugging. The forte of GUI builders is their WYSIWYG nature. You create windows, for example, by drawing them with a mouse, and the GUI builder records your feat by placing the corresponding C code into an ASCII file.

Both UIM/X and Guide provide sophisticated interfaces. They are themselves good examples of professional GUI programming: UIM/X for OSF/Motif, and Guide for OpenWindows on Sun platforms. Both stand out because they do not rely on a user interface language–a method used by some other GUI builders, but a painful one when you look at a GUI builder from the point of view of "How fast can I begin programming in an X environment?"

continued





Designed to ease the development of graphical user interfaces, both UIM/X (top) and Guide (bottom) are themselves good examples of sophisticated interfaces.

The Building Cycle

Development with a GUI builder occurs in multiple phases: layout, behavior specification, testing, refinement, and code generation. Each phase has its own important issues. You should evaluate a GUI builder on how well it handles the peculiarities of each phase. Also evaluate how well it interacts with widgets (objects such as windows, buttons, and icons) across all phases.

The actual steps involved in GUI building are (1) select and draw interface objects, (2) customize objects through a built-in property editor, (3) interactively test the objects in the development session, (4) save the work that has been developed so far, (5) generate the source code (and all support files, including the makefile) for the new application, and (6) after exiting the GUI builder, compile the sources to produce the application's executable files.

One of the most impressive things about UIM/X is that it supports all of Motif

The second phase of development is to specify behavior, sometimes referred to as the *feel* of the application. Layout involves specifying the static initial state. Behavior specification involves setting all of the dynamic elements of the interface. Behavior specification traditionally accounts for about 60 to 80 percent of the entire user interface development time.

UIM/X from Visual Edge

If you want a complete GUI builder for Motif, it's impossible to overlook UIM/X. In the past year, Visual Edge has released UIM/X for various Motif platforms, including HP/Apollo, Digital Equipment Corp., and Motorola systems. Visual Edge even supports UIM/X for Motif on Sun and AT&T platforms (but has a separate product, Open Look Express, for the Open Look environment).

For this review, I loaded UIM/X on an HP 9000/360 with HP-UX and X11.3. HP resells UIM/X under the name Interface Architecture. I have also used UIM/X on other platforms, including Sun SPARCstations and 386 systems. The standard UIM/X software includes six binders of documentation and lists for $5,000 dollars, the standard price for workstation versions. The 386 versions sell for $2,500. Installation is script-driven.

One of the most impressive things about UIM/X is that it supports all of Motif: every shell, widget, gadget, convenience dialog, and resource. This level of support is admirable, considering Visual Edge migrated UIM/X from an Xlib product to Motif and has since kept abreast of changes in the OSF environment. It plans to release a Motif 1.1 version in early 1991.

UIM/X has several advanced features that make it stand out among GUI builders. Some of the features I respect most include UIM/X's built-in C interpreter, its ability to edit an object's property values, and an easy-to-use programming subroutine library for objects. I was also impressed with the menu editor, which supports pop-up, pulldown, and option menus. UIM/X's other capable editors are for text, action tables, translations tables, events, declarations, and, as mentioned, properties. Oddly enough, it does not have built-in editors for pixmaps and fonts, but it does include sample applications that provide this support. UIM/X's menu system provides full access to creating on-screen objects. Once you start UIM/X, the main Project Window is displayed, containing a menu bar of options, controls for setting design or test mode, an area reserved for user interface icons, a C interpreter window, and a window for status and error messages.

Using UIM/X

You begin using UIM/X in the layout phase of a project. First you select the Create option from the Project Window menu bar. Then, in most cases, you select an item from the Managers submenu. After choosing a manager widget, you size the object with the mouse and click when you finish. Immediately afterward, the object appears in the location of the mouse pointer.

UIM/X makes a clear distinction between parent and child objects. Objects drawn on the root window are top-level shells. UIM/X treats these objects as the building blocks of the application. Each component is an independent entity within the application, but linked together by UIM/X. Windows, dialog boxes, and icons are good examples of root window objects. Child objects are any object linked to a root window object such as file boxes, buttons, and text boxes.

Creating child objects is easy. You simply position the mouse over the parent object and click. The menu for child objects gives you options to create child widgets such as Primitives, Gadgets, Managers, and Menus. If other children already exist for a parent widget, selecting the Children option produces a window of icons that represent the existing children. Clicking on any of these icons displays a menu that allows you to modify the selected child widget.

Behavior specification in UIM/X consists of three main components: specifying callbacks, choosing the application window behavior, and selecting a set of objects that comprise the initial state of the application. UIM/X's property editor provides the mechanics for these operations. The editor is in the form of a dialog box, which displays status information such as the default widget instance name, widget parent's instance name, and areas reserved for setting and displaying widget properties and values. The properties listed are defined by the associated widget class.

Of Widgets and Callbacks

UIM/X gives you extensive control over widgets. Widget properties are divided into four categories–core, specific, behavior, and constraint–implemented as a set of four exclusively selected radio buttons. In the core, specific, and behavior categories, you can always customize objects. In the constraint category, you can dither buttons that are a child of a constraint widget.

The core properties include those commonly available in all widgets such as background color, x/y locations, height/width information, and so on. The specific properties are those that apply to a particular instance of a widget. These properties are unique to a particular class of widget. And most importantly, behavior properties are used to specify the code for a callback function.

Specifying a callback in the property editor amounts to typing in your callback code. The property editor gives you a text entry window to type in the appropriate C code. The UIM/X component of your application has access to all callback arguments as well as to all Motif, Xt, and Xlib function calls. You can also make calls to your own widgets, which you can link in with UIM/X. All in all, this approach more than adequately displaces the need for a user interface language such as the D language in Teleuse.

For constrained widgets, the constraint properties editor permits specification of how widgets are attached to their parents or other widgets. These are usually children of constraint widgets such as the form and paned window widgets; setting these constraint properties determines the layout arrangement and resizing policies of all of the children.

Incorrect values for object properties are detected by UIM/X. An error message dialog box appears when you specify invalid boundary data. Additionally, UIM/X reports the error in its main

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REVIEW HIGHLIGHTS

UIM/X

Visual Edge Software, Ltd.
3870 Cotê Vertu
St. Laurent, Que.
Canada H4R 1V4
514-332-6430
415-948-0753

Built-in C interpreter; portable; full Motif support; access to all widget resources; library sources; available on numerous platforms; quality technical support.

Lacks built-in color, pixmap, and font editors; must make a mistake to discover valid resource values; quality of documentation needs a lift; distribution package should include more sample applications.

Version: *1.0.*
Systems: *AT&T, DEC, SCO UNIX, Interactive, Intel, HP/Apollo, Sun, IBM, CDC, Data General, Silicon Graphics, Tektronix, Quest, Motorola, AT&T, ICOM.*
Licensing: *Per CPU.*
Price: *$2,500 for 386 systems; $5,000 for workstations.*
Support: *Available from the vendor.*
Warranty: *90 days on media.*

Project Window. In appropriate cases, UIM/X displays valid boundary values, so you won't repeat the error. In practice, however, it would be more efficient if UIM/X presented valid values during initial entry of the boundary data.

A Library of Convenience

UIM/X comes with a small, easy-to-use Convenience Library for complex tasks such as converting resources, allocating colormap entries, automatically managing children of dialog shells, and handling special cases of geometry management. The library also performs substantial error checking, notification, and recovery to help in the debugging process.

Because of the Convenience Library, even new users can begin specifying simple behaviors within minutes and more complex ones in days. There is also a high-performance version of the function library available, without error checking for finished applications. The library source code is available for porting applications to any platform that supports C, X11, and Motif development components.

As a developer you have flexibility in the specification and handling of application window behavior, through the use of translation and accelerator tables that enable you to graphically specify events and tie them to C code actions. Besides common events, UIM/X lets you choose from any (Xt) Toolkit event. Once a translation or accelerator table is defined, behavior of existing widgets can be customized by adding Tables to them. UIM/X supports all three Toolkit modes of modifying widget behavior: augment, override, and replace.

Dynamic Initial State

The third main component of user interface behavior is the dynamic initial state of the interface. When popping up an interface, about 15 to 20 percent of the resources in most interfaces depend on the state of the application. UIM/X allows you to specify and test parametric user interfaces, that is, user interfaces with a dynamic initial state.

C expressions are permitted as the initial value of any resource or property value. The C expression is evaluated when the widget is created, both by UIM/X when building the interface, and also in the generated code. The C expression can be any legal one that returns the correct type. For example, legal expressions include a function call (with arguments) into the application, and an application global variable.

The C interpreter can access and call compiled code in your application, permitting you to develop and test parametric user interfaces. UIM/X also permits you to build reusable parametric components. Reusable components can act as an easier and faster alternative to building custom widgets, or simply as a means to enhance productivity on an ongoing basis from project to project.

The function call that UIM/X generates for the creation of parametric components can take arguments, as specified by the developer. The arguments may be used in the C expression in the resource slots of any widget in the component. Components can be both "top level" interfaces or "children" deep within the widget hierarchy. UIM/X also supports multiple instances of parametric interfaces and components within an application, each with a separate context.

From the C Side

When you finish a user interface in UIM/X, the C interpreter lets you build, modify, and test your interface with the underlying application running, eliminating the time-consuming compile/link/run cycle.

UIM/X's interpreter can mix compiled and interpreted code. It can modify compiled global variables, and even pass the address of an interpreted routine into a compiled routine for de-referencing and execution. Because you can link your compiled application code to UIM/X, you can build and test your user interface with the whole application there to drive it.

You can use the C interpreter to rapidly develop and test interfaces, and once you are satisfied, compile them individually for performance. This can be thought of as an incremental approach for application development. You can enter interface C code into callbacks and completely separate the user interface from the application code, providing a highly modular approach to application development.

When you are satisfied with an interface, you can generate C code by placing the pointer over an icon representing an interface object and selecting the C code option. UIM/X generates portable C code, X resource files, and a special file used to recreate your UIM/X interface session, called an interface file. You can choose to include (or exclude) any resource in a resource file, providing control over the degree of end user customization.

Aside from a few minor annoyances, UIM/X is a complete and well-rounded package that automates almost as much of the programming process as feasible. It lacks some amenities such as color editing and error checking, as well as a few more, but UIM/X gives you a lot. Most of all, it gives you an in-depth way to integrate Motif into a development project–and save time and money in doing so.

Guide from Sun Microsystems

Guide is distinguished by a mature design. More so than any of its Motif competitors, its design is both compact and utilitarian and insightful, not to mention perfectly in keeping with Open Look guidelines. Beyond design, Guide offers the basics required of a GUI builder, but it is not without shortcomings, such as poor object grouping and no development utilities for callback functions.

The problem with Guide–if you can even call it a problem–is it takes you halfway up the trail and then expects

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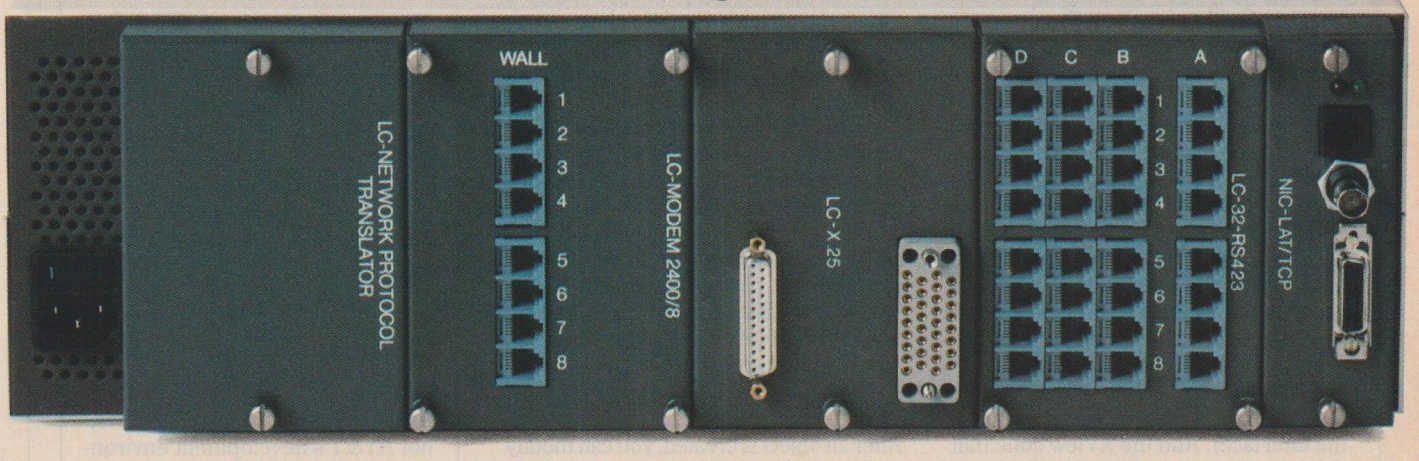

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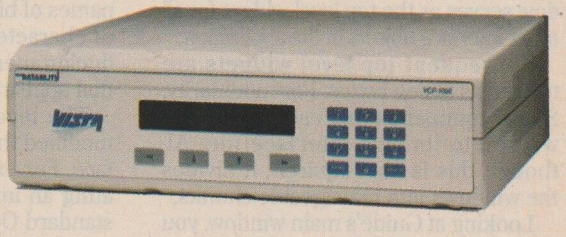

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you to lead yourself. Guide does not give you all the tools that you need to really exploit a GUI such as Open Look, which itself is partly to blame because of its narrow style tenets.

Mostly to blame is the idea behind Guide. Sun apparently believed that developers want a power boost, but not the booster. Guide gives you the power to create an Open Look application, but it expects you to be satisfied with its idea of what an application looks like (although its visions are diverse). It also expects you to want to do most of your own programming after the callback level, so much of the program flow logic is not automated.

If Guide sounds like a front-end product, it is. But so be it. I recommend it to both novice and experienced programmers. It easily cuts a project by 30 to 40 percent and cuts down on lengthy recompiles (because even the most experienced Open Look developers make fundamental mistakes when creating the interface). And the XView code that Guide produces is as close to flawless as I have seen.

For this review, I loaded Guide on a SPARCstation 1, running under OpenWindows 2.0. From Sun, I received the Guide development package, consisting of a single quarter-inch tape and four binders of documentation. A "Getting Started" booklet is included and the installation is script-driven. The retail price of Guide is $250.

Guide to Guide

Guide was the fifth or sixth GUI builder I've had occasion to evaluate. As an experiment, I tried using it without reading the documentation. After an hour, I discovered that I could generate simple interfaces at rapid rates and save them to disk. At this point, I began reading the manual.

Once I got to know Guide, it became clear that no Open Look programmer would want to work without it. The usual way to begin Guide is to create a main window for the application. The main window serves as the top-level widget for all other interface objects in the application.

Subsequent top-level widgets are treated as dialog boxes. For modularity, Sun recommends that each window is written to its own interface file. Although this is not required, it divides the windows into manageable chunks.

Looking at Guide's main window, you see an example of almost every type of interface object available in Open Look. For the most part, using Guide is straightforward: you select an object you want and use the mouse to size and position it. It's okay to create an object and decide later what to do with it. If you drop the object on top of a previously drawn object, Guide designates the new object as a child of the background object. If you drop the object on the root window, Guide treats it as a subsequent top-level shell.

Guide hides most of the details of the widget hierarchy. You are free to concentrate on building your application. If you make an inappropriate choice or attempt to do something that doesn't make sense, Guide simply doesn't let you do it.

All of Guide's objects comply with the Open Look style guide. Menu selections let you build buttons, menus, cascading menus, base windows, pop-up windows, a control pane, a pre-built terminal pane (complete with scrollbars), scrolled text panes, labels, text fields, valuator scales, scrolled lists, setting widgets (check or selection widgets), and slider controls.

Modifying Objects

After an object is created, you can modify it via a property editor, which contains data unique to the given object. The property editor window lists existing widget properties and gives you a selection of different keyboard and mouse events to link to the object–a logical, but limited, method of editing properties.

Unlike UIM/X, Guide does not fully access all resources of an interface object. This is the result of rigid Open Look style guidelines that mandate fixed resource values for interface objects. To modify such resources, you must resort to hard coding in C. A common example occurs when you want to modify an object's color: because Guide's color editor doesn't let you create custom colors, nor allow you access to all the standard colors defined in the default colormap (`rgb.txt`), you must pull up the source file and hack away.

Creating menus in Guide is by far the easiest of all UIMS packages. Using another very powerful menu-building technique, you can build totally iconic control interfaces by specifying the names of bitmaps that are used in place of character button label names, producing menus of push-button controls that appear to be selectable icons.

The layout of the menus is easily modified through a menu control interface. For example, rather than just creating an interface containing a row of standard Open Look push buttons with textual labels, Guide lets you create your own bitmaps and specify these for the new button shape. You can arrange these bitmap buttons into rows or columns to create a palette of selectable icons. This is known as creating "glyph" buttons, and lets you build some dazzling interface components that look much nicer than ordinary push buttons.

Before Compiling

Once the user interface of your application has been completed, you can save it by selecting the Save or Save As items from the File pulldown menu on the Guide main window. For new applications, the Save As item must be used, producing a dialog in which you specify the directory and file name for the interface code, resulting in a GIL file (appended with ".G"). Graphical Interface Language files are used by Guide to recreate the drawn interface on-screen, and as input to the source code generator, **gxv**.

To create the source code for an interface, you use the **gxv** utility that is a part of Guide, normally executed manually from a terminal window or any UNIX command prompt. The **gxv** module reads in a GIL file and produces XView source code output, as well as all headers and a makefile. If there is already an

REVIEW HIGHLIGHTS

Guide
Sun Microsystems, Inc.
Mountain View, CA 94043
800-872-4786; 415-960-1300

Well-designed interface; support for all Open Look interface components; faithful adherence to Open Look style guide; good documentation and technical support.

Available only for OpenWindows, not AT&T's development environment; limited code generation capabilities; limited callback creation mechanism; lacks sufficient sample applications.

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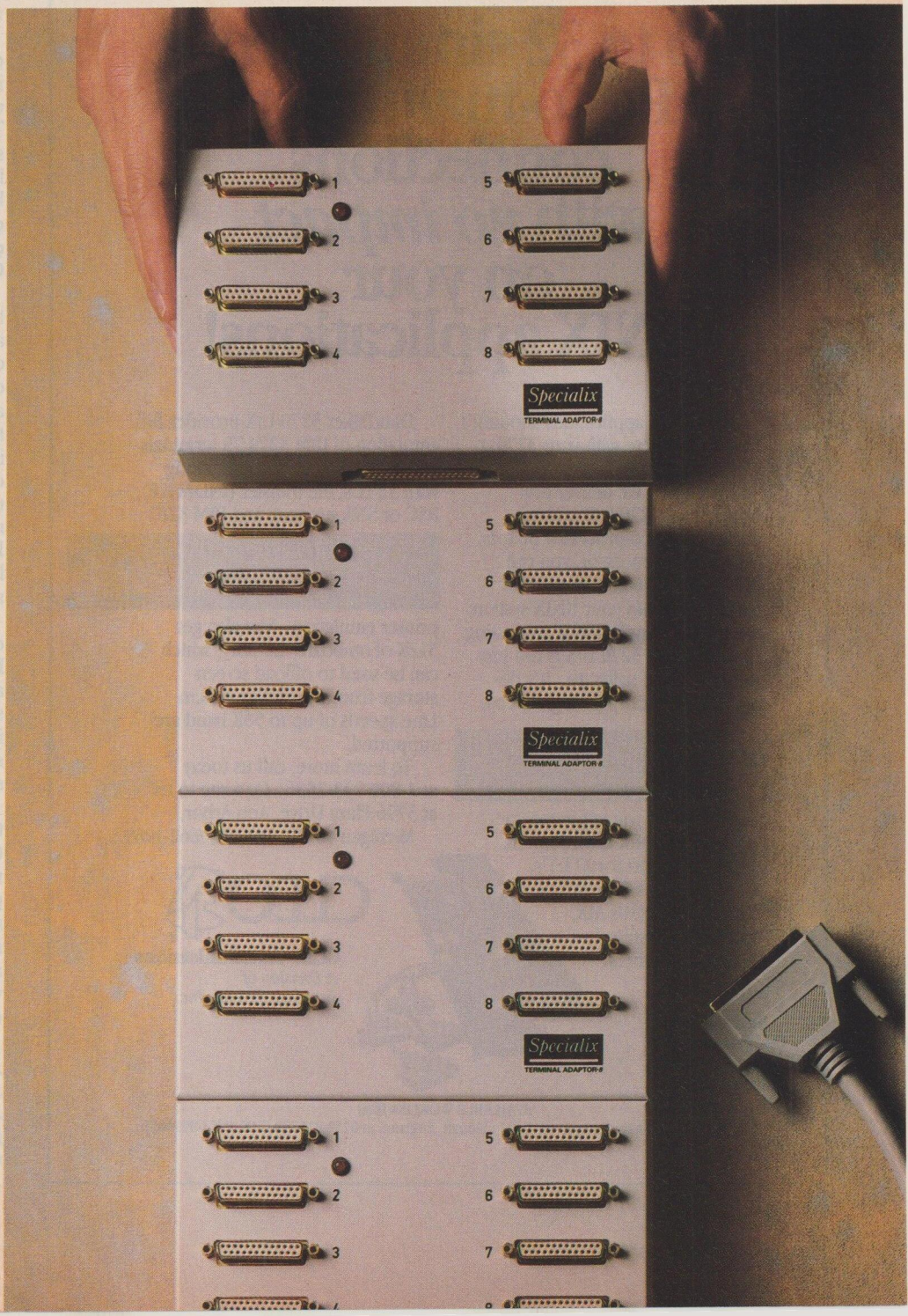

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existing makefile in the target directory, a new one is not created to preserve any customizations that may have occurred.

All source code previously produced, however, is replaced with the newly generated source. The **gxv** program generates only the code needed to create the elements of your user interface. It does not generate your callbacks for the interface controls; you must do this yourself manually.

After you have generated your own sources for the interface callbacks, you must modify the makefile by hand to include them into the compilation and linking process. (The names of your callback functions must match those you specified during the interface creation process, as these are the names generated in the **_stubs.c** produced by **gxv** and are the linkage between your routines and your Guide-generated interface.)

Guide Persona

Overall, Guide is impressive, although it often leaves you with the feeling of a missing sherpa. Guide's most disappointing limitation is its total lack of callback development facilities.

Why be harsh on this point? Because it forces you to exit Guide and piece together program flow–in vi, emacs, or what have you these days–by editing the application files. Besides the mundane feeling, this also opens the door to the introduction of errors into otherwise good code produced by Guide.

Another drawback to Guide is it produces only XView code. This is alarming to development shops that plan on using AT&T's Open Look Intrinsics Toolkit as well as XView. Guide does support X11R4 libraries, however, and it hints of more to come: my Guide distribution software contained **gxv++** and **g2ps**, undocumented companions to **gxv**. To me, these indicate support for C++ and NEWS.

Lastly, I must criticize Sun's zeal for the graphic response paradigm (to coin a phrase). Throughout Guide, complex choices of options–things that a developer could spend all night worrying about–are reduced to the bare essentials, leaving little room for individual ingenuity. Sun commits this error of omission by implementing its graphic response controls as multiple choice mutually exclusive, non-exclusive, or Boolean choices. Indeed, Sun could have included more edit boxes to override existing choices.

The Guide documentation is well done and lives up to the Sun's usual high standards. It contains a section on additional programmer tips and even a section on generating source code using **gxv**. Surprisingly, there is even a section in the documentation that describes the GIL file format.

All in all, Guide is a basic, but efficient, tool for increasing development productivity in Sun's OpenWindows environment. For its time and place, it is a perfect fit to the development community's expectations. But two questions remain unanswered: Can Guide keep abreast of programmers' needs? And will Sun port Guide to AT&T's version of Open Look? ■

Steven Mikes writes UNIX and X Window System programming books and lectures on X/Motif/Open Look programming, including programming with GUI builders. He can be reached on Compuserve at 74216,1537.

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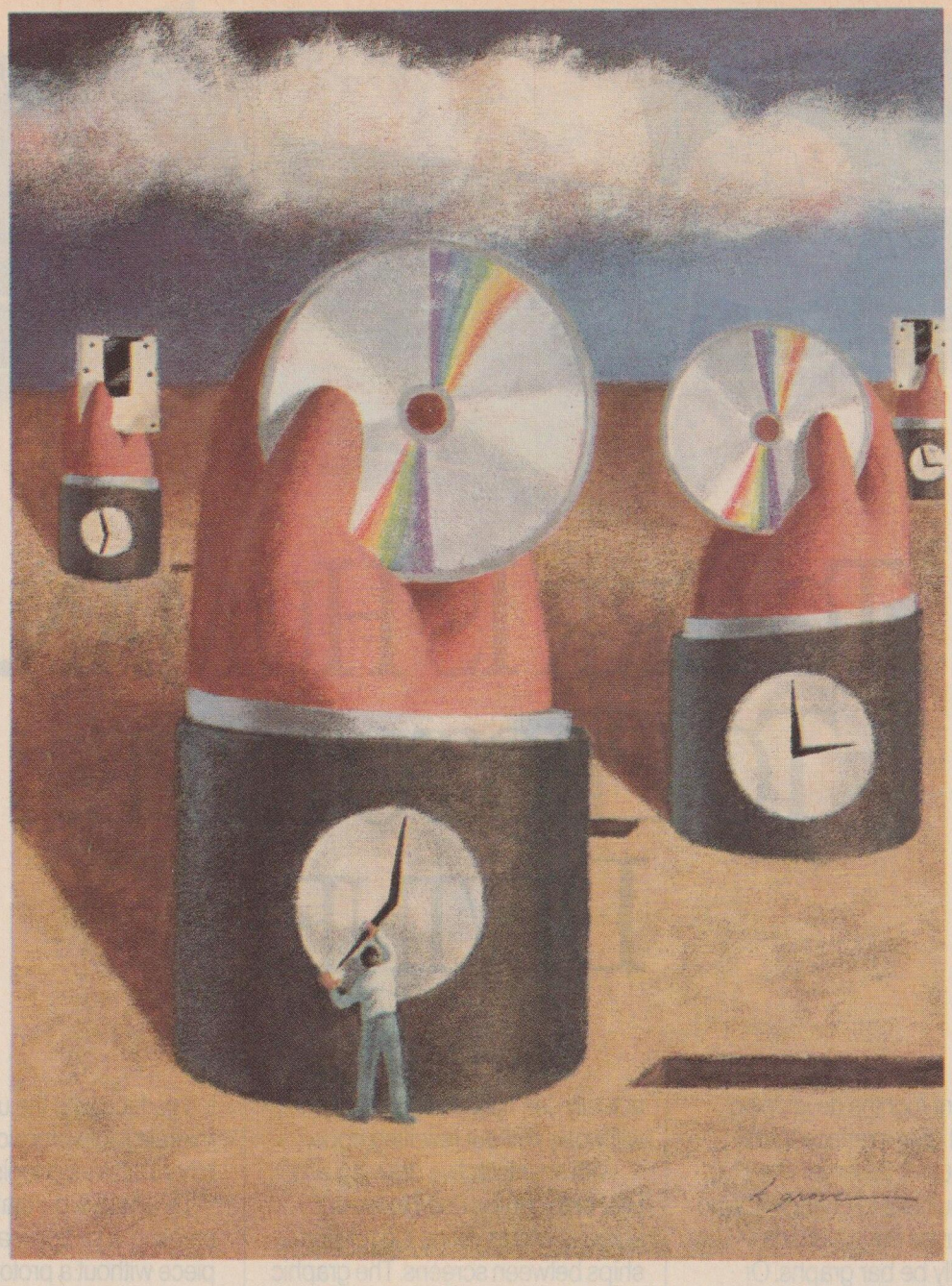

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Update by Frank Hayes

LOOKING FOR A UNIX SECURITY BLANKET

The phrase "UNIX security" may sound like a contradiction in terms to some long-time UNIX users. Memories of large and small security problems–and major breaches like 1988's Internet worm–have underlined a problem with open systems–they have a tendency to be very open, and not very secure.

But tighter security for UNIX is on the way. In fact, it's already arriving in systems from vendors ranging from AT&T to The Santa Cruz Operation (SCO). And there's a new generation of security standards and committees, including the U.S. Defense Department's "Orange Book," the IEEE's Posix 1003.6 committee, TRUSIX, the European ITSEC, and a new ISO committee (SC27) on security techniques. Whether you want security in your UNIX or not, within the next few years you're likely to have it.

Classifieds

It's no surprise that much of the demand for increased computer security comes from the U.S. government–particularly the Defense Department. Government computer system purchases have taken a decided turn toward open systems in the past few years. But the Defense Department has to match those open systems with its existing security classifications–"top-secret," "classified," and "unclassified."

In the Defense Department's system, you've got to have "clearance" to read documents at one of those three levels. For example, if you have "classified" clearance, you can read both classified and unclassified documents, but not top-secret documents. You're also not allowed to share information with anyone who has a lower clearance than you. For example, you can't (legally) let someone with clearance restricted to unclassified documents see information rated as classified.

The Defense Department's system also has subject categories, such as "NATO" or "nuclear." You may have top-secret clearance in one category, but not in another; to read a particular document, you must have the necessary clearance in the appropriate subject area.

This style of security is hard enough to maintain with paper documents. On a typical UNIX system, it's almost impossible to enforce. To get a handle on the problem, the National Security Agency's National Computer Security Center (NCSC) created a set of computer system standards for the Defense Department. Officially, they're called the "Trusted Computer System Evaluation Criteria," but they're widely known as the "Orange Book" standards. No existing UNIX systems come close to meeting the requirements of the highest Orange Book security levels. But several vendors, hoping to improve their chances of sales to the federal government, have included lower-level Orange Book requirements in their versions of UNIX.

Whether you want tighter security in your UNIX system or not, within the next few years you're likely to have it

A Matter of Trust

There are seven classes of "trusted computing bases" in the Orange Book system, ranging from D (the least secure class) to A1 (the most secure). In the Orange Book system, an earlier letter in the alphabet is more secure than a later letter, and within the same letter division, a higher number is more secure than a lower number. Thus, in order of security, the Orange Book classes are D, C1, C2, B1, B2, B3, and A1.

Class D systems have "minimal protection." That doesn't mean they have no security features at all, but that they fail to meet the requirements for a higher evaluation class.

C-class systems include features for discretionary protection; the individual user has control over the file's classification. These systems still aren't compatible with the traditional security clearances, because users at one level of clearance might be able to exchange data with users at another level. Instead, all users on a particular C-class machine must share the same "system high" clearance level. Class C1 systems offer enough security to let users keep their data private from other users and prevent it from being accidentally read or destroyed. Class C2 demands tighter log-in procedures, auditing of security-related events, and isolation of system resources.

B-class systems incorporate mandatory protection–the beginnings of real support for classified users and data. Class B1 systems have "labeled security protection," with required security procedures and "sensitivity labels" for each file. Class B2 adds a major challenge for UNIX–the requirement to be able to account for every line of code in the system throughout its lifetime, in order to prevent "trap doors," "Trojan horses," and other intentionally built-in security holes. B2 may be as far as UNIX systems will ever go.

Class B3 must securely handle all data accesses, prevent all tampering, signal all security-relevant events, and still be small enough to test and analyze. That means eliminating all parts of the system that aren't essential to enforcing security policies.

The most secure class, Class A1, requires "verified designs." A1 systems are functionally the same as B3 systems, but an A1 system has also been formally defined, not just proven by test. The Orange Book system also makes provision for systems even more secure than A1 but not yet technically practical.

continued

NCSC tests computer systems to certify that they meet various Orange Book levels. Gould, for example, had the first C2-rated UNIX; AT&T's System V/MLS, based on System V Release 3, was the first to receive B1 certification. Even at the lower levels, Orange Book certification isn't a quick process–it can take two years or more.

Posix Goes Orange

Of course, Orange Book security is completely voluntary. If a computer company isn't trying to sell security features to the U.S. government, those classifications aren't necessary. But as part of the IEEE's Posix standards effort, much of the Orange Book may become the basis for all UNIX security standards.

The Posix security committee, IEEE 1003.6, is working to develop security standards for the Posix system interface, commands, and utilities, as well as for system administration. The committee's work is designed to be merged with that of other Posix working groups, so that security won't be optional in a Posix-compliant system–the goal is to make all Posix systems secure.

Posix security standard 1003.6 has been given to international standards organizations, with IEEE voting as early as the summer of 1991

That may be a mixed blessing, because the Posix security work is based almost exclusively on U.S. military security standards. Government security standards from other countries haven't been considered. Neither has the fit with international standards such as the X.400 standard for electronic mail and X.500 standard for naming services. And the Posix working group hasn't explicitly considered the needs of commercial users; businesses may find that the demands of military security aren't really appropriate to business needs.

And matching any kind of additional security to existing UNIX approaches is difficult. In each of its four working areas–Least Privilege, Discretionary Access Control, Mandatory Access Control, and Audit–the committee is trying to preserve traditional UNIX methods for both users and system administrators. But it's not easy to preserve the prerogatives of freewheeling superusers, in the face of Orange Book security.

Still, the Posix security work is well on its way to becoming an international standard. The 1003.6 drafts have been submitted to international standards organizations for review and comment, and the committee could send the proposed standard to the IEEE for voting as early as the summer of 1991.

TRUSIX, ITSEC, and SC27

Posix isn't the only set of UNIX security standards on the block. The U.S. Defense Department is also sponsoring TRUSIX, a group whose members include NCSC (which developed the Orange Book criteria) and AT&T. The TRUSIX work parallels much of the Posix security effort, and the two groups are comparing notes on areas such as audit mechanisms and discretionary access controls. However, some TRUSIX goes further to include a formal security model and descriptive top-level specification–the things that will be necessary if UNIX is ever to make it into the top tier of Orange Book-compliant systems.

A group of European users has its own ideas about security. Last summer, the group–representing business users from the U.K., West Germany, France, and the Netherlands–announced its commercial alternative to the Orange Book. The Information Technology System Evaluation Criteria, or ITSEC, defines two kinds of security levels. One type, with five levels, would be hierarchical, like the Orange Book. A second would address five different specific security areas, such as integrity, availability, and networks. There are also seven classes of assurance. The ITSEC system is more complicated than the Orange Book, but because it's been designed by business users it may be better oriented to commercial needs.

And a new international standards committee will be dealing with security issues as well. ISO SC27, the International Standards Organization's "Security Techniques" committee, has been formed to bring together security-related standards activities that in the past have been spread across many different working groups. SC27 is expected to examine areas such as encryption and user authentication–things that aren't confined to one operating system, or even to computer systems in general.

Meeting the Market

Only the Orange Book standards have had a major impact on UNIX systems. Some UNIX vendors now routinely submit their operating systems for Orange Book security rating (although because of the time required to certify the systems, many products may not be officially certified before they've become obsolete in the marketplace).

Others, like AT&T, are building security into special versions. AT&T's UNIX System Laboratories (USL) recently announced UNIX System V Release 4 ES (enhanced security). The new version, which USL is working on with the help of Amdahl and Motorola, claims it will be certified at Orange Book Class B2 level, with some features at the B3 level.

However, improved Orange Book-style security doesn't always have the desired results, especially for UNIX users and system administrators for whom security isn't a primary goal. For example, SCO UNIX 3.2 version 2.0 bills itself as having Class C2 security–not an especially high level. But some system administrators who upgraded to that version quickly discovered that more security meant more work. Adding users suddenly meant a more complex process involving two separate menu systems. And there didn't seem to be any way to turn the security off.

To its credit, SCO says it will solve those problems; future versions will streamline the process of adding users and will offer a simple way of resetting the many system switches required to reduce security to a minimum. The company also says it will add a set of security commands, so system administrators won't be required to use its menu systems. But those security administration details won't go away, and SCO intends to offer systems with even higher security levels in the future.

Meanwhile, it's still not at all clear that Orange Book security has any place in most business computing environments. Enforcing separation of different levels of users–the equivalents of top-secret, classified, and unclassified clearances–isn't practical for most businesses, even if someone finds a purpose for it. At the same time, real business security needs, such as better user authentication, aren't being addressed in official international standards such as Posix.

In short, UNIX *will* be more secure for the government, but it has a long way to go for business. ■

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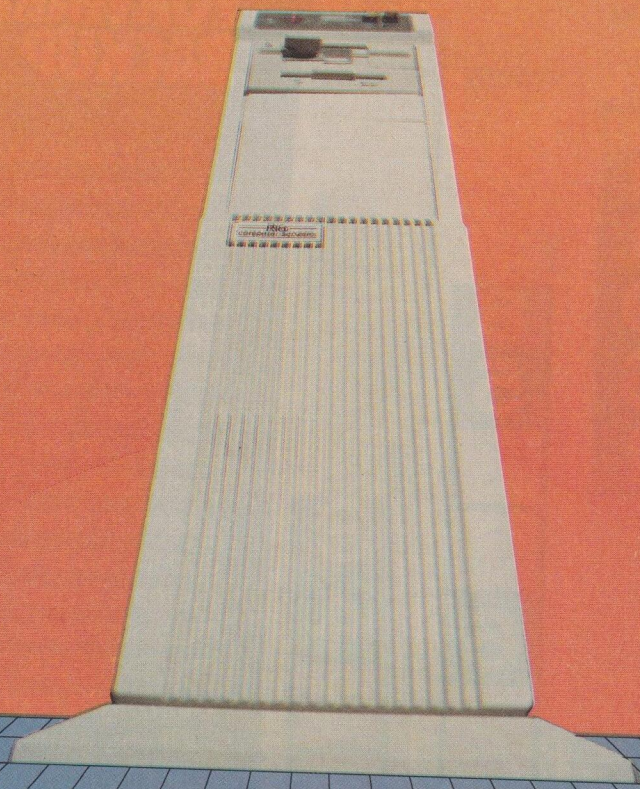

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MOVING ON TO C++

This tutorial series will teach you the object-oriented version of the C language

By Gail and Paul Anderson

Paul Anderson is president of Anderson Software, a UNIX training company specializing in courses on UNIX, C, and C++. Gail Anderson, co-founder of Anderson Software, designs and writes software in C++. They are the co-authors of two textbooks: *The UNIX C Shell Field Guide*, from Prentice-Hall, and *Advanced C: Tips and Techniques*, from Howard Sams & Co.
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If you consider yourself an experienced C programmer, then you're probably comfortable using `malloc()` to allocate storage, changing data types with casts, and using the `sizeof` operator to achieve portability. You've learned to use function prototypes and structures to organize data, and you write modular programs to simplify program maintenance. You feel comfortable using pointers, knowing when and how to dereference them, and you know how to take addresses of variables. You understand the memory requirements of the code you write: how much static data, heap memory, and stack space your program requires.

So why do you feel uneasy every time you pick up a journal on programming? Maybe it's because the programming industry is talking about C++, a language that incorporates object-oriented features into a procedural language based on C. As a professional programmer, you'd probably like to learn what the fuss is all about and overcome that feeling of fear.

In this three-part tutorial, we'll examine C++ from a C programmer's point of view. We'll start with a base knowledge of C, and move quickly into C++ syntax. You'll see how C++ encourages you to build a language-supported wall around code modules, which protects the integrity of your software system and helps you write better programs.

This first article explores this concept of *data encapsulation*, which specifies how you can legally access a data structure while at the same time hide certain parts of it. Whereas the C programming language tests a programmer's inner strength and builds character by following an "anything goes" philosophy, C++ is the programmer's friend, providing compile-time error messages that enforce data encapsulation. Above all, C++ gives you, the C programmer, a chance to learn something new.

C++ is a young language that's coming of age quickly. Bjarne Stroustrup developed C++ at AT&T, with his work culminating in a commercial product in 1985. The product, called *cfront*, is a source-to-source translator from C++ to C. Today there are many C++ products available—both translators and compilers—running under diverse operating systems such as UNIX, MS-DOS, and MacOS.

As the C++ programmer population explodes, more compilers, development environments, and industrial-strength class libraries are coming to market. Compiler companies are vying for the loyalty of the "C boomers:" C programmers who are migrating to C++. Although the C++ language is still evolving, work is under way to formally standardize the language through the American National Standards Institute (ANSI). The Standards Committee X3J16 had its initial meeting in December 1989 and hopes to have a standard by December 1992.

A Starting Point with C

C++ is a language built upon C, so let's take a first look at C++ from a C perspective. To do this, we'll examine a C program (K&R C) and translate it into C++. Along the way, we'll discover some improved features, and you'll see that the end result is a better program.

Listing 1A is a C program that reads numbers from standard input (you type them in) into an integer array, sorts the numbers and displays them on standard output (the screen). The program then reads in a second set of numbers, repeating the sorting and printing steps.

Function `main()` declares two variables `a` and `b` of type `int *` (pointer to integer) and an integer variable `i` for stepping through the integer arrays. The program allocates heap storage for integer arrays `a` and `b` using the standard library routine `malloc()`, checks the return value against `NULL`, and exits if `malloc()` fails. If successful, `main()` fills array

a with integer numbers read from standard input using the `scanf()` library routine. Note that the `scanf()` routine requires the address of its argument, `a[i]`, to work correctly (line 38). Function `sort()` orders the integers into ascending order and calls `xchg()` to exchange out-of-order integers.

Finally, `main()` prints each element of array a. The program then repeats the fill, sort, and print steps for array b. Before terminating, the program releases the allocated heap storage for a and b using the `free()` library routine. Listing 1B shows a sample run with output.

This program is not very elegant. Not much thought was put into the design, and maintenance could be difficult. The program works as it stands, however. Indeed, `main()` does most of the work, allocating only the sort step to support functions. Let's see how we can improve the program in C by using better design techniques.

A Modular C Program

Listing 1A's `main()` routine is too repetitive, suggesting that we should write support routines for creating, manipulating, and freeing a sorted integer array. By doing this, we create a more readable program that declares an integer array type, then initializes, fills, sorts, and prints the arrays before releasing them. Each of these steps maps nicely into separate functions.

What should the data structure look like? The Listing 1A `sort()` function (lines 4-14) requires an integer pointer `int * ip` as well as an integer size argument `int size`. Let's group these two data items into a structure as shown in Listing 2A. Now we can pass a pointer to this structure in each of our support routines (see Listing 2B). Each function uses a pointer to a `struct SortArray` variable, which maintains a consistent calling syntax among all the functions. And passing structures by address instead of by value is usually more efficient.

Listing 2C is a rewrite (still in C) of the program shown in Listing 1A. Although the two programs are functionally equivalent, Listing 2C is superior because it groups the variables `buffer` and `size` together in a structure and provides separate functions to manipulate the `struct SortArray` variable. Function `main()` does not directly modify either `size` or `buffer` but relies on the SortArray support routines instead. Function `main()` declares two variables `mybuf1` and `mybuf2` of type `struct SortArray`

LISTING 1: As a starting point for our examples we present a K&R-style C program for sorting numbers entered from the keyboard.

A. Listing of the `sorter` *program:*

```
 1  /* program to sort numbers: Version 1 */
 2  #include <stdio.h>
 3
 4  /* sort array v into ascending order (bubble sort) */
 5  sort(ip, size)
 6  int * ip;
 7  int size;
 8  {
 9     int i, j;
10     for (i = size-1; i >= 1; i--)
11        for (j = 0; j < i; j++)
12           if (ip[j] > ip[j+1])
13              xchg(&ip[j], &ip[j+1]);
14  }
15
16  /* exchange the values of the two memory locations ip1 and ip2: */
17  xchg(ip1, ip2)
18  int * ip1;
19  int * ip2;
20  {
21     int temp = *ip1;
22     *ip1 = *ip2;
23     *ip2 = temp;
24  }
25
26  #define MAX1    5
27  #define MAX2    7
28
29  main()
30  {
31     int *a, *b, i;
32     if ((a = (int *) malloc (MAX1 * sizeof(int))) == NULL)
33        exit(1);
34     if ((b = (int *) malloc (MAX2 * sizeof(int))) == NULL)
35        exit(1);
36     for (i = 0; i < MAX1; i++) {
37        printf("Input a number: ");
38        scanf("%d", &a[i]);
39     }
40     sort(a, MAX1);
41     for (i = 0; i < MAX1; i++)
42        printf("%d ", a[i]);
43     printf("\n");
44
45     for (i = 0; i < MAX2; i++) {
46        printf("Input a number: ");
47        scanf("%d", &b[i]);
48     }
49     sort(b, MAX2);
50     for (i = 0; i < MAX2; i++)
51        printf("%d ", b[i]);
52     printf("\n");
53
54     free((char *)a);
55     free((char *)b);
56  }
```

B. Sample run of program `sorter` *with output:*

```
$ sorter
Input a number: 55
Input a number: 33
Input a number: 100
Input a number: 45
Input a number: 77
33 45 55 77 100
Input a number: 3
Input a number: 79
Input a number: 82
Input a number: 0
Input a number: 48
Input a number: 65
Input a number: 51
0 3 48 51 65 79 82
$ □
```

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LISTING 2: The program shown in Listing 1A can be improved using conventional C modular design techniques.

A. First, declare an appropriate data structure, which can be referenced by all the program modules. The `SortArray` *structure contains an integer pointer and integer size:*

```
struct SortArray {
   int * buffer;
   int size;
};
```

B. Second, design each support routine to use a pointer to a `struct SortArray` *parameter:*

```
struct SortArray *sa;
bufinit(sa, n)
sort(sa)
fillbuf(sa)
print(sa)
bufrelease(sa)
```

C. Here's the listing of our modular C program, which is a rewrite of Listing 1A:

```
 1  /* program to sort numbers: Version 2 */
 2  #define MAXSIZE 20
 3
 4  struct SortArray {
 5      int * buffer;
 6      int size;
 7  };
 8
 9  /* sort array v into ascending order (bubble sort) */
10  sort(sa)
11  struct SortArray * sa;
12  {
13     int i, j;
14     int * v = sa->buffer;
15     for (i=sa->size-1; i >= 1; i--)
16        for (j=0; j < i; j++)
17           if (v[j] > v[j+1])
18              xchg(&v[j], &v[j+1]);
19  }
20
21  /* exchange the values of the two memory locations ip1 and ip2: */
22  xchg(ip1, ip2)
23  int * ip1;
24  int * ip2;
25  {
26     int temp = *ip1;
27     *ip1 = *ip2;
28     *ip2 = temp;
29  }
30
31  /* fill buffer with numbers from standard input: */
32  fillbuf(sa)
33  struct SortArray * sa;
34  {
35     int i;
36     for (i=0; i< sa->size; i++) {
37        printf("Input a number: ");
38        scanf("%d", &sa->buffer[i]);
39     }
40  }
41
```

continued

and allocates heap storage for these structures in function `bufinit()`. Function `bufinit()` returns 1 if it's successful or 0 otherwise. The program fills the integer arrays (function `fillbuf()`), sorts the integers into ascending order (function `sort()`), and prints each array using function `print()`. Function `bufrelease()` releases the allocated heap storage.

This C program attempts to provide (as best it can) a sorted array type. By using the `SortArray` data structure as a parameter and providing access only through the support routines, the program "encapsulates" the data. The C language, however, does nothing to support true data encapsulation. That is, within `main()` it's possible to access the data members of variables `mybuf1` and `mybuf2` directly. Listing 2D provides a sample `main()` routine that uses the same data structure `struct SortArray` but breaks the rules for proper usage. Lines 10 and 11 assign directly to structure members `buffer` and `size`, and in doing so, create an erroneous value for variable `mybuf1`. This C code is perfectly legal, even though it produces a dysfunctional program.

What is an Object?

Let's see if we can improve this situation. We can create a new data type or object type called SortArray, and use it with the same confidence that we use any of the built-in data types found in C. What is an object? Basically, it's a variable consisting of storage (a data structure) and all the support routines that determine the object's behavior. Data encapsulation provides the wall that enforces correct usage of an object. That is, feedback on the legal uses of a SortArray variable should come at compile-time. C++ does just this by allowing you to group together data structures and functions in your source code and by limiting access to an object through those routines you specify.

Let's proceed now to our first C++ example, a translation of Listing 2C, shown in Listing 3A. In this initial C++ version, we group the SortArray functions together and list their prototypes within the SortArray structure declaration. A function prototype is a declaration that tells the compiler the type and number of a function's arguments, as well as the function's return type. Now these member functions "belong" to the SortArray structure type.

Controlled Access

We use the keywords `private` and `public` to specify access to the function and data names from outside of the structure. (Declarations within a structure are called member declarations, just like in C.) Member data items `buffer` and `size` are designated `private`. Member function `xchg()` is also private. This means that your program can't access them except indirectly through `SortArray`'s member functions.

On the other hand, member functions `bufinit()`, `bufrelease()`, `sort()`, `fillbuf()`, and `print()` are all labeled `public`, making them accessible from outside the member functions. To invoke these public member functions, we simply use structure member notation. For example, `mybuf1.fillbuf()` calls function `fillbuf()` for variable `mybuf1`.

The structure definition (Listing 3A, lines 6-17) provides the function pro-

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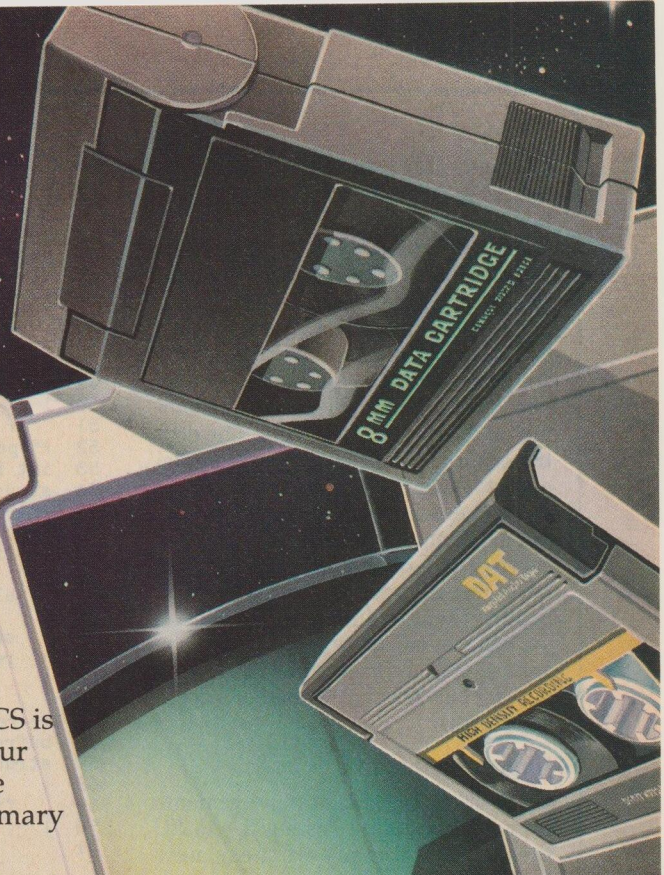

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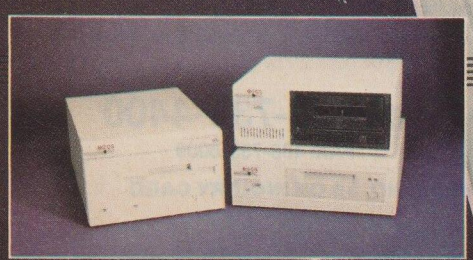

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totypes and data declarations for `struct SortArray`. Member function code follows (or, it could be in another file). The code for each member function includes the return type, the structure name, the function name, and argument list. For example, the notation `void SortArray::sort(void)` specifies `SortArray` member function `sort()` that returns void (nothing) and takes no arguments. The double colon (`::`) is the scope resolution operator, which separates the owning data type (here `SortArray`) from the function name. In Listing 3A, function `main()` can only access public members; like a structure in C, you must qualify the structure member with a variable name of type `SortArray`. Listing 3B shows examples of legal and illegal structure member access statements.

Improvements to C

C++ offers significant improvements over C. Comparing Listing 3A to 2C demonstrates many of these new features.

Listing 2 continued

```
42  /* pass a pointer to a SortArray and print: */
43  print(sa)
44  struct SortArray * sa;
45  {
46     int i;
47     for (i=0; i< sa->size; i++)
48        printf("%d ", sa->buffer[i]);
49     printf("\n");
50  }
51
52  /* pass a pointer to a SortArray and initialize: */
53  int bufinit(sa, n)
54  struct SortArray * sa;
55  int n;
56  {
57     if (n > 0)
58        sa->size = n;
59     else
60        sa->size = MAXSIZE;
61     sa->buffer = (int *)malloc (sa->size * sizeof(int));
62     return(sa->buffer ? 1 : 0);
63  }
64
65  /* release heap storage pointed to by SortArray pointer: */
66  bufrelease(sa)
67  struct SortArray * sa;
68  {
69     free((char *)sa->buffer);
70  }
71
```

continued

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Comments. C++ provides consecutive slashes // to begin a comment; the comment terminates at the end of the line. This style makes short, single-line comments very easy. The style is less error-prone because you don't have to remember to include a closing delimiter. C++ also supports the conventional C-style comment.

Declarations. Declarations in C++ are more general than in C:

- You no longer need to include the keyword `struct` when declaring a structure variable (compare Listing 3A, line 69 and Listing 2C, line 74). This shorthand notation allows a more natural use of user-defined data types, such as `SortArray`.
- The keyword `const` specifies a variable whose value will not change (read-only variable) (Listing 3A, line 4). The compiler does not allow you to use read-only variables as *lvalues* (you cannot change their values). Therefore, constant variables must be initialized when they are declared. In general, you should use constant variables instead of the C preprocessor's `#define` constructs since constant variables are subject to the C++ compiler's type conversion and scope rules. Furthermore, symbolic debuggers can access constant variable names.
- While C requires that all variable declarations appear before any executable statements within a block, C++ allows you to declare a variable anywhere inside a block. A variable's scope is active until the end of the block where it's declared. This feature promotes better code readability when you see the declaration of a variable near the place where it is used. In our example, functions `sort()`, `fillbuf()`, and `print()` use inte-

Listing 2 continued

```
72  main ()
73  {
74      struct SortArray mybuf1, mybuf2;
75      if (!bufinit(&mybuf1, 5))
76          exit(1);
77      if (!bufinit(&mybuf2, 7))
78          exit(1);
79
80      fillbuf(&mybuf1);
81      sort(&mybuf1);
82      print(&mybuf1);
83
84      fillbuf(&mybuf2);
85      sort(&mybuf2);
86      print(&mybuf2);
87
88      bufrelease(&mybuf1);
89      bufrelease(&mybuf2);
90  }
```

continued

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ger counters within a `for` loop. In C++, the declaration of the control variable may appear inside the `for` loop: `for (int i = 0; i < size; i++)`, which is equivalent to `int i; for (i = 0; i < size; i++)`. The scope of variable `i` in both examples is the block that contains the `for` loop, not the block inside the loop. Thus, a second `for` loop in the same block can't redefine the same integer counter `i`.

Default Parameters. C++ allows you to specify a default value that a parameter receives if the caller does not explicitly provide one. Function `bufinit()` (Listing 3A, line 54) contains a default parameter. So, for example, `mybuf3.bufinit()` is equivalent to `mybuf3.bufinit(MAXSIZE)`.

Member Functions. C++ supports member functions in addition to member data:

- Within a member function, member names (such as `size` or `xchg()`) refer to the variable that was used to invoke the member function. Thus, inside function `bufinit()` (Listing 3A, line 56) we write `size =n` which, when called with `mybuf1.bufinit(5)`, assigns 5 to `mybuf1.size`.
- In this example, the member functions of `struct SortArray` no longer require a pointer to `struct SortArray` parameter. `SortArray` member functions must be called with a variable of type `SortArray`, making the parameter implicit. Line 81 of Listing 2C is `sort(&mybuf1)` but in our C++ program (Listing 3A, line 76), this maps to `mybuf1.sort()`. And in line 75 of Listing 2C, `bufinit (&mybuf1, 5)` becomes `mybuf1.bufinit(5)` in line 70 of Listing 3A. The C++ notation is analogous to passing a pointer to `mybuf1` since `mybuf1`'s data is now accessible inside member function `bufinit()`.

Reference Variables. A reference is a variable that refers to an object of its declared type. For example, in Listing 3C, reference `rf` is another name for integer `i`. (Reference `rf` *refers* to variable integer `i`.) You must initialize a reference, and you can't make it refer to another object after initialization. For example, we can manipulate variable integer `i` through `rf` (see Listing 3D). But we can't change reference `rf` to refer to integer variable `j`.

One useful application of references is in argument passing, as illustrated with function `void SortArray::xchg(int &ip1, int &ip2)`. Here arguments `ip1` and `ip2` are integer references ("int ref's" for short). The references are initialized to the actual arguments when the program calls function `xchg()`. Therefore, when we access `ip1`, we're really referring to the integer argument `buffer[j]` (see Listing 3A, line 33: `xchg(buffer[j], buffer[j+1])`). Note that we don't have to "dereference" the reference parameter within the function (a reference is not a pointer), as illustrated in Listing 3A, lines 22-24. The function prototype tells the compiler (and documents for programmers) that `xchg()` uses reference parameters. In general, reference arguments simplify the notation (compare the function `xchg()` in Listings 2C and 3A) and we don't have to remember to pass the address

Listing 2 continued

D. Here's a sample program `main()` *routine that "breaks the rules" for proper usage of* `struct SortArray`*:*

```
1  main ()
2  {
3     struct SortArray mybuf1, mybuf2;
4     if (!bufinit(&mybuf1, 5))
5        exit(1);
6     if (!bufinit(&mybuf2, 7))
7        exit(1);
8     fillbuf(&mybuf2);
9
10    mybuf1.buffer = mybuf2.buffer;
11    mybuf1.size = 100;
12
13    sort(&mybuf1);
14    print(&mybuf1);
15
16    bufrelease(&mybuf1);
17 }
```

LISTING 3: We can provide better data encapsulation with a C++ program. We group the SortArray functions together and list their prototypes within the SortArray structure declaration.

A. A translation of Listing 2C into C++, which shows data encapsulation of a `SortArray` *object:*

```
1  // program to sort numbers: Version 3
2  #include <stdlib.h>
3
4  const int MAXSIZE = 20;
5
6  struct SortArray {
7  private:
8     int * buffer;
9     int size;
10    void xchg(int &, int &);
11 public:
12    int bufinit(int);
13    void bufrelease(void);
14    void sort(void);
15    void fillbuf(void);
16    void print(void);
17 };
18
19 // exchange the values of the two memory locations ip1 and ip2:
20 void SortArray::xchg(int & ip1, int & ip2)
21 {
22    int temp = ip1;
23    ip1 = ip2;
24    ip2 = temp;
25 }
26
27 // sort array into ascending order (bubble sort)
28 void SortArray::sort(void)
29 {
30    for (int i=size-1; i >= 1; i--)
31       for (int j=0; j < i; j++)
32          if (buffer[j] > buffer[j+1])
33             xchg(buffer[j], buffer[j+1]);
34 }
35
```

continued

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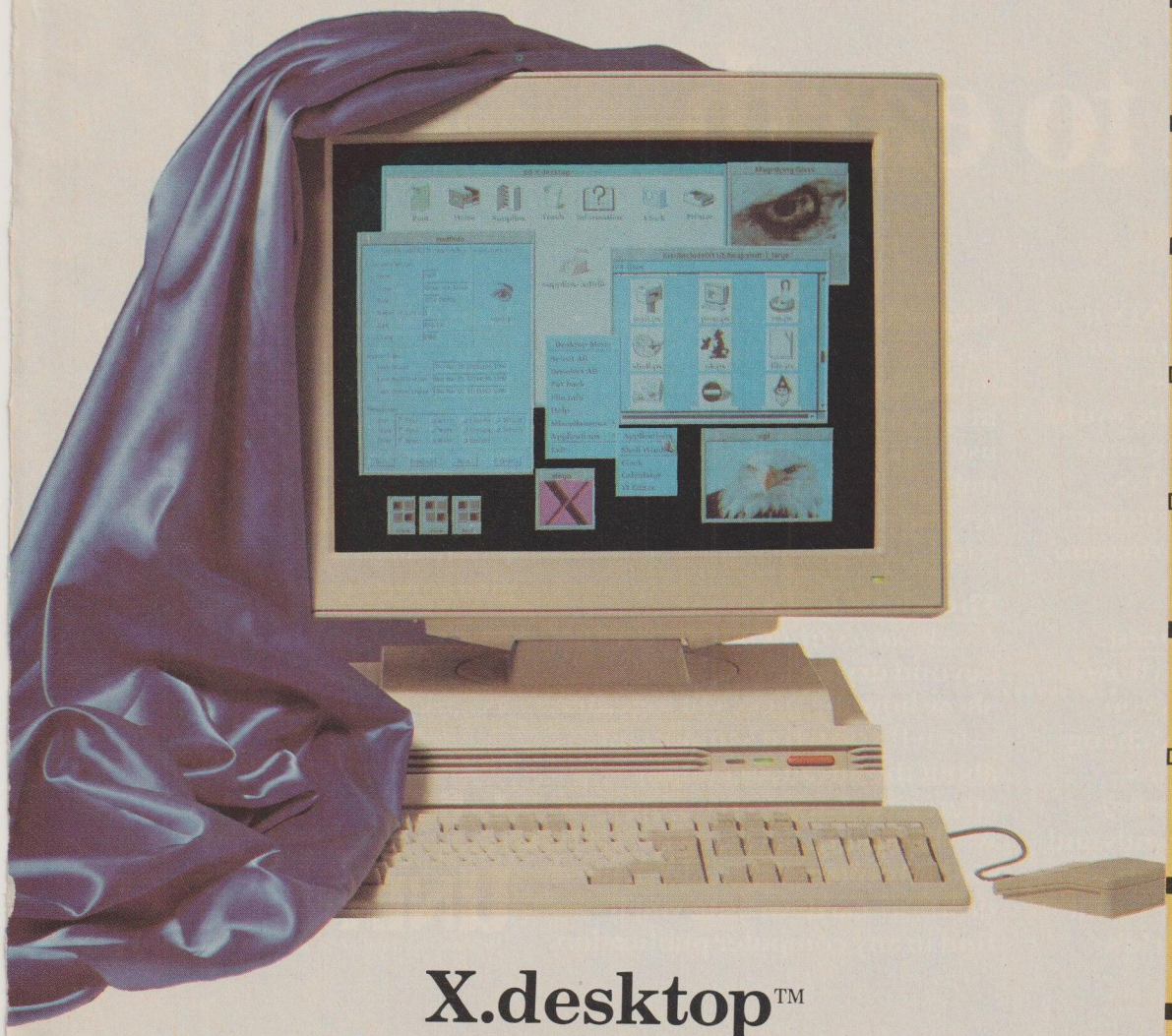

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```
36  // fill buffer with numbers from standard input
37  void SortArray::fillbuf(void)
38  {
39     for (int i=0; i < size; i++) {
40        printf("Input a number: ");
41        scanf("%d", &buffer[i]);
42     }
43  }
44
45  // print buffer:
46  void SortArray::print(void)
47  {
48     for (int i=0; i < size; i++)
49        printf("%d ", buffer[i]);
50     printf("\n");
51  }
52
53  // initialize buffer:
54  int SortArray::bufinit(int n = MAXSIZE)
55  {
56     size = n;
57     buffer = (int *)malloc (size * sizeof(int));
58     return ( buffer ? 1 : 0);
59  }
60
61  // release heap storage
62  void SortArray::bufrelease(void)
63  {
64     free((char *)buffer);
65  }
66
67  main ()
68  {
69     SortArray mybuf1, mybuf2;
70     if (!mybuf1.bufinit(5))
71        exit(-1);
72     if (!mybuf2.bufinit(7))
73        exit(-1);
74
75     mybuf1.fillbuf();
76     mybuf1.sort();
77     mybuf1.print();
78
79     mybuf2.fillbuf();
80     mybuf2.sort();
81     mybuf2.print();
82
83     mybuf1.bufrelease();
84     mybuf2.bufrelease();
85  }
```

continued

(see Listing 2C, line 18 and Listing 3A, line 33).

Scope Resolution Operator. Function definitions require the structure name and scope resolution operator `::` to explicitly name the structure scope (Listing 3A, lines 20, 28, 37, 46, 54, and 62). The structure name and scope resolution operator tie the function definition to its prototype declaration, supporting the important C++ feature of data encapsulation.

We're Not There Yet. The C++ program in Listing 3A is significantly better than the C program in Listing 2C. We prevent the errors we made in Listing 2D by having the compiler detect illegal references to the hidden data in `SortArray`. We have logically grouped the support functions needed by `SortArray`, giving us not only a data structure but also a set of functions (the member functions) that define the behavior of a `SortArray` object.

Classes

Listing 4 is a second C++ version of our sorter program. This version offers significant improvements over Listing 3A. First, we have replaced the definition of `struct SortArray` with `class SortArray`. The keyword `class` defines a data structure and functions whose default access is private. The default access of `struct` is public. For newcomers to C++, however, it is comforting to know that a `class` is really just a `struct` with a different default access.

Constructors and Destructors. While the program in Listing 3A suc-

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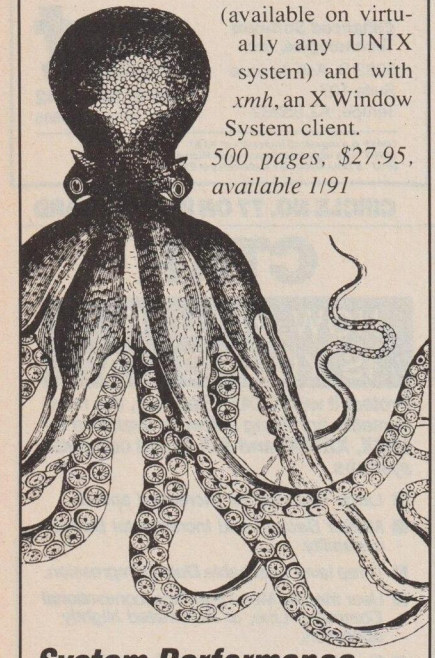

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Listing 3 continued

B. Here are some examples of accessing a structure in C++:

```
SortArray mybuf1;
mybuf1.bufinit(5);      // legal
mybuf1.print();         // legal
sort();                 // illegal: unqualified access
mybuf1.size = 10;       // illegal: private data
mybuf1.xchg(j, k);      // illegal: private function
```

C. Here's how to declare an integer reference `rf` *to refer to the same integer as* `i`*:*

```
int i;
int & rf = i;
```

D. Here's an example showing manipulation of the integer reference `rf`*:*

```
rf = 25;  // sets i to 25
int j = 3;
rf = j;   // sets i to 3
```

LISTING 4: Our final version of the sorting program takes advantage of C++ improved features:

```
 1  // program to sort numbers: Version 4
 2  #include <stream.h>
 3  #include <stdlib.h>
 4  #include <new.h>
 5
 6  void no_space(void)
 7  {
 8     cerr << "No heap memory.\n";
 9     exit(1);
10  }
11
12  const int MAXSIZE = 20;
13  class SortArray {
14     int * buffer;
15     int size;
16     void xchg(int &, int &);
17  public:
18     SortArray(const int n=MAXSIZE) {size=n; buffer=new int [size];}
19     ~SortArray(void) { delete [size] buffer; }
20
21     void sort(void);
22     void fillbuf(void);
23     void print(void) const;
24  };
25
26  // exchange the values of the two memory locations ip1 and ip2:
27  inline void SortArray::xchg(int & ip1, int & ip2)
28  {
```

continued

cessfully limits access to the functions that manipulate a SortArray variable in a legal way, there's no way to insure that the programmer will remember to properly initialize (via function `bufinit()`) or clean up (via function `bufrelease()`) a SortArray variable. C++ handles this problem by allowing you to define how a class variable should be created and initialized. Creation and initialization occur when you declare a class variable. For example, `SortArray mybuf1` declares variable `mybuf1` of type `SortArray`.

We specify how a variable should be created through a class constructor. A class constructor is any function whose name is the same as the class name. You may specify more than one class constructor for a class (as long as the argument lists differ), and constructors don't have return types. Line 18 of Listing 4 contains the (only) class constructor for class `SortArray`. The SortArray constructor replaces the functionality of `bufinit()` in Listing 3A. We will discuss its contents shortly. Note that we still use a default parameter value, `MAXSIZE`.

Function `bufrelease()` of Listings 2C and 3A releases the heap storage allocated in `bufinit()`. In Listing 4, we use a C++ class destructor for cleanup tasks. A class destructor is a function whose name is the same as the class name preceded by a tilde (~).

Listing 4 continued

```
29      int temp = ip1;
30      ip1 = ip2;
31      ip2 = temp;
32  }
33
34  // sort array into ascending order (bubble sort)
35  void SortArray::sort(void)
36  {
37      for (int i=size-1; i >= 1; i--)
38          for (int j=0; j < i; j++)
39              if (buffer[j] > buffer[j+1])
40                  xchg(buffer[j], buffer[j+1]);
41  }
42
43  // fill buffer with numbers from standard input
44  void SortArray::fillbuf(void)
45  {
46      for (int i=0; i < size; i++) {
47          cout << "Input a number: ";
48          cin >> buffer[i];
49      }
50  }
51
52  // print buffer:
53  void SortArray::print(void) const
54  {
55      for (int i=0; i < size; i++)
56          cout << buffer[i] << ' ';
57      cout << '\n';
58  }
59
60
61  main ()
62  {
63      void (*prev_fp)() = set_new_handler(no_space);
64  // declaration automatically invokes constructor:
65      SortArray mybuf1(5), mybuf2(7);
66
67      mybuf1.fillbuf();
68      mybuf1.sort();
69      mybuf1.print();
70
71      mybuf2.fillbuf();
72      mybuf2.sort();
73      mybuf2.print();
74
75      set_new_handler(prev_fp);
76  // block exit automatically invokes destructor:
77  }
```

Listing 4, line 19 contains the class destructor for class SortArray, which replaces function `bufrelease()` in Listings 2C and 3A. There can only be one class destructor for a class; it takes no arguments and has no return type.

What advantages do constructors and destructors offer us? When you declare a class variable, the compiler automatically generates code to invoke the class constructor. Similarly, when that class variable goes out of scope, the compiler automatically generates code to invoke the class destructor. This improves program robustness, because we don't have to remember to initialize or clean up our data objects.

Free Store Operators. The SortArray constructor allocates heap storage using the C++ operator `new`, similar to the `malloc()` library routine. Operator `new`, however, allocates the number of bytes depending on the type of its operand. The statement `buffer = new int [size]` is functionally equivalent to `buffer = (int *) malloc(size * sizeof(int))` in C. We request enough bytes for `size` integers. Operator `new`'s return type (in this case a pointer to an integer) makes casting unnecessary.

The SortArray destructor frees the heap storage using the C++ operator `delete`. The statement `delete [size] buffer`, for example, frees `size` chunks of storage pointed to by `buffer`. The compiler determines how much heap memory you want to free through `buffer`'s type. In this example, specifying `size` is optional. However, we recommend using the size parameter because it is required when you use more complicated data structures (for example, arrays of class

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objects instead of arrays of built-in data types like integers).

Detecting Heap Allocation Errors. In C, it's important to check `malloc()`'s return value against `NULL` every time you request heap storage. In C++, operator `new` may call a function when heap allocation fails. To do this, supply routine `set_new_handler()` with a function pointer, as shown in Listing 4, line 63: `set_new_handler (no_space)`. Function pointer `no_space` holds the address of our error handler routine. We define function `no_space()` in lines 6-10 of Listing 4. Function `set_new_handler()` returns the previous handler function pointer, allowing you to nest calls and save the previous value.

Inline Functions. When you place the code within a class (or struct) declaration, you're asking the compiler to generate the function code inline. This eliminates function call overhead and makes your program execute faster but at the expense of some increase in code size. Here, Listing 4, line 18 contains not only the constructor function prototype, but the code as well. Note that the class destructor is also inline. In fact, you may request any function to be inline, but (like requesting register variables in C and C++) it's only a request. If the function is too large or complex, the compiler ignores your request.

The inline qualifier is convenient for small, often-used functions where function call overhead might affect program performance. Since C++ encourages the use of many small functions, inline code generation becomes an important performance feature. Another way to request an inline function is to include the `inline` keyword with the function definition, as illustrated in Listing 4, line 27: `inline void SortArray::xchg(int & ip1, int & ip2)`.

const with Functions. You may also use `const` with function parameters, which makes it illegal for a function to change that parameter's value. The SortArray constructor specifies that its argument `n` (if one is provided) will not change. A statement such as `n = 0` within this function generates a compile-time error.

Similarly, we may designate a function as `const`. This means that the class variable that invokes the function cannot be modified. To create a constant function, just place the keyword `const` after the function declaration in the prototype (Listing 4, line 23): `void print(void) const` and in the function definition (Listing 4, line 53): `void SortArray::print (void) const`. Now if we inadvertently modify the class variable's data (such as `buffer++`), C++ generates a compile-time error.

Input and Output Streams. Listing 4 improves functions `fillbuf()` (lines 43-50) and `print()` (lines 52-58) by using the C++ istream (input stream) operator `>>` and ostream (output stream) operator `<<`. Similar to C, C++ defines three standard I/O stream variables: `cin` for standard input, `cout` for standard output, and `cerr` for standard error. Function `no_space()` uses `cerr`.

The I/O stream operators give users "type-safe" I/O. Contrast this to standard C's `printf()` where you must specify through a format string the variable type: `printf("%d ", buffer[i])`. Worse, when using standard C's `scanf()`, you must remember to pass the address of the argument: `scanf("%d", &buffer[i])`.

You'll be happy to know that in C++ the input operator `>>` uses a reference parameter which means you don't have to remember to pass the address (the compiler does the work for you). Thus, input becomes: `cin >> buffer[i]`. Because of the return type of the input and output operators, it's possible to chain operators and operands together, as in: `cout << buffer[i] << ' '` which writes `buffer[i]` and the constant character <space> to the ostream variable `cout`.

Data encapsulation allows you to create a safe data type by specifying and controlling access to it. C++ supports data encapsulation through the class construct by grouping data and functions together. The private and public keywords control access to the class, and constructors and destructors support automatic initialization and cleanup tasks. The net result is that the programmer may implement functions based on an object's behaviors.

In our next article, we'll examine the concept of an abstract data type: the ability to create a user-defined data type that behaves like a built-in data type. We'll show you the recipe to build and use an abstract data type correctly in C++. ■

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CIRCLE NO. 102 ON INQUIRY CARD

Dr. Rebecca Thomas

LINE GRAPHICS AND MULTILINE RECORD SORTING

This month, Joe Vigil provides a handy program for using the line graphics capabilities introduced in the System V Release 3 curses library. Sue Andarmani provides a clever approach to handling multiline records, supplying a sorting program for an example. For feedback, Mike Tiller overcomes a shortcoming of the `scpp` program introduced in my June 1990 column. Enjoy.

Connecting the Dots

Dear Dr. Thomas:

When our system was upgraded to Release 3 of System V, I noticed that curses and terminfo now support line graphics. I've included a C program (`prtscrn`) designed to print a screen using these line graphics capabilities. It reads a screen template text file and converts the characters within into the appropriate line graphics escape sequences for my display device and sends them to the program's standard output file. After invoking `prtscrn` with the name of the template file, my terminal screen is repainted with line graphics characters. Alternately, I can redirect the standard output to a file for subsequent use as a "screen generator." Of course, the actual escape sequences are dependent on the terminal type, so you may need a different screen-generator output file for each terminal type on your system.

[*Doctor's notes:* Part A of Listing 1 shows the `prtscrn` program source code, Part B a sample template data file, and Part C a makefile. The data file contains characters from the character set listed in the left-hand column of Table 1. The right-hand column of the table describes the corresponding glyph that would be printed on a DEC VT100 terminal. The middle column lists the line-drawing character codes used on one of my terminals (terminfo name is AT386).

When using an AT386 terminal, the Release 3 (and later) System V curses package will convert the characters listed in the left column (of Table 1) to the character set in the middle column and then embeds them in the necessary escape sequences to produce the desired display. Each character pair of the `acsc` terminfo capability defines the mapping from the left- to the middle-column listed in the table. Listing 1D shows the `acsc` definition for the AT386 terminal.

As an experiment, I manually converted the character codes in the Listing 1B data file to the corresponding ones listed in the middle column of Table 1, then I used the simpler program (Listing 1E) to obtain the same result as when I used `prtscrn` with the Listing 1B data file. Of course, the latter approach requires a terminal-dependent data file, but it does illustrate the translation provided by the curses library using the `acsc` terminfo capability. Besides the `acsc` capability, the terminfo entry for your terminal also needs to define the `smacs` (start using alternate character set) and `rmacs` (end using alternate character set) capabilities.]

[*Doctor's explanation of* `prtscrn`. Lines 14-17 make sure that only one argument was specified. Lines 18-21 attempt to open the file named as an argument. The calls on line 23 establish the initial conditions for using curses: `initscr()` initializes curses, that is, it creates the internal screen representations and reads the terminfo database; `nonl()` tells the terminal device driver to turn off newline-to-carriage return mapping (for more efficient operation); `noecho()` disables echo of input characters; and `scrollok(stdscr, TRUE)` enables scrolling of the output.

The while loop encompassing lines 25-82 reads characters from the input file. If the character is the "toggle character" (defined on line 2) then the character set flag (`acs`) is toggled by lines 26-31. If the character isn't a blank or newline, the switch statement encompassing lines 36-73 tests to see if it's one of the VT100 alternate character set codes. If so, then `c` is reset to the appropriate alternate character set variable (names begin with `ACS_`) for the user's terminal type. Line 75

TABLE 1: Some alternate character sets and descriptions of their displayed glyphs.

VT100 character	AT386 character	Glyph description
`	`	diamond
a	a	checker board (stipple)
f	f	degree symbol
g	g	plus-over-minus sign
j	Y	lower-right corner
k	?	upper-right corner
l	Z	upper-left corner
m	@	lower-left corner
n	E	plus sign
o	o	scan line 1
q	D	horizontal line
s	s	scan line 9
t	C	left tee
u	4	right tee
v	A	bottom tee
w	B	top tee
x	3	vertical line
~	~	bullet

moves the cursor to the appropriate screen coordinates and writes the character to the virtual screen. Lines 77-80 recompute the proper coordinates for the next character to be displayed. The `refresh()` call on line 83 updates the physical screen with the contents of the virtual screen, and `endwin()` returns the terminal modes to their original state.]

Joe Vigil
MIS Manager
Avibank Mfg., Inc.
Burbank, Calif.

Taming the Multiline Record

Dear Dr. Thomas:

I've enclosed a shell script named `mlinesort` that sorts a file of multiline records. Such records are quite common in everyday tasks; some examples include address files, catalogs, and bibliographies. However, multiline records, which have newline-delimited fields, are somewhat more difficult to deal with than records that fit on a single line because UNIX utilities are designed to deal with records whose fields are separated not by newlines but some other character, such as a space, tab, colon, or tilde.

The heart of my program is a `sed` command that prepares the input file for ordering by `sort` by converting the multiline record with newline-delimited fields into a single line record with colon-separated fields. (Note that the field separator need not be a colon, but it should be some character that is not likely to appear in the data.) After sorting, the `tr` command converts the colon-separated fields back to newline-delimited ones. The program handles records of varying lengths (limited by `sed` to 1,024 characters each), and expects to see exactly one blank line between records.

[*Doctor's note:* Part A of Listing 2 shows the `mlinesort` program, Part B some sample input data, and Part C the resulting output from `mlinesort`.]

[*Doctor's explanation of* `mlinesort`. Lines 8-27 process the command-line options. If `getopts` is available, it sets `OPTIND` to 1, so the test on line 8 is true and lines 9-17 will process the command line (see December 1990 "Answers to UNIX" column for a description of `getopts` operation). Otherwise, lines 19-26 perform the same function.

After any options have been shifted, the case statement encompassing

LISTING 1: Many terminals have an alternate character set for drawing simple graphics. The SVR3 curses library supports line graphics using this alternate character set. We present some sample programs and data files to illustrate this capability.

A. Listing of the `prtscrn` *program, which converts the terminal-independent VT100-alternate character set to the standard glyphs listed in Table 1:*

```
 1  #include <curses.h> /* includes <stdio.h> */
 2  #define TOGGLECHAR '\\' /* character to toggle character sets */
 3  char *sccsID = "@(#) prtscrn  Print graphic screen; Joe Vigil";
 4
 5  main(argc, argv)
 6  int argc; char **argv;
 7  {
 8      FILE    *fp;        /* file pointer for input file */
 9      int     c,          /* character read from file */
10              x = 0,      /* column coordinate */
11              y = 0,      /* row coordinate */
12              acs = 1;    /* use alternate char set flag */
13
14      if (argc != 2) {    /* if not one argument */
15          fprintf(stderr, "Usage: %s file\n", argv[0]);
16          exit(1);
17      }
18      if ((fp = fopen(argv[1], "r")) == NULL) { /* if can't open */
19          perror(argv[1]);    /* display reason */
20          exit(2);
21      }
22      /* set up curses: */
23      initscr(); nonl(); noecho(); scrollok(stdscr, TRUE);
24
25      while ((c = getc(fp)) != EOF) { /* while not end of file */
26              if (c == TOGGLECHAR) { /* if toggle character */
27                  if (acs) {  /* if using alternate */
28                      acs = 0;    /* switch to standard */
29                  } else {        /* if using standard */
30                      acs = 1;    /* switch to alternate */
31                  }
32                  c = ' ';    /* blank out TOGGLECHAR */
33              }
34              if ((c != ' ') && (c != '\n')) { /* not sp, nl */
35                  if (acs) {  /* if in alternate char set mode */
36                      switch(c) { /* substitute alternate char */
37                          case 'l' :
38                              c = ACS_ULCORNER; break;
39                          case 'm' :
40                              c = ACS_LLCORNER; break;
41                          case 'k' :
42                              c = ACS_URCORNER; break;
43                          case 'j' :
44                              c = ACS_LRCORNER; break;
45                          case 'u' :
46                              c = ACS_RTEE; break;
47                          case 't' :
48                              c = ACS_LTEE; break;
49                          case 'v' :
50                              c = ACS_BTEE; break;
51                          case 'w' :
52                              c = ACS_TTEE; break;
53                          case 'q' :
54                              c = ACS_HLINE; break;
55                          case 'x' :
56                              c = ACS_VLINE; break;
57                          case 'n' :
58                              c = ACS_PLUS; break;
59                          case 'o' :
60                              c = ACS_S1; break;
61                          case 's' :
62                              c = ACS_S9; break;
63                          case '`' :
64                              c = ACS_DIAMOND; break;
65                          case 'a' :
66                              c = ACS_CKBOARD; break;
67                          case 'f' :
68                              c = ACS_DEGREE; break;
69                          case 'g' :
70                              c = ACS_PLMINUS; break;
71                          case '~' :
72                              c = ACS_BULLET; break;
73                      }       /* end switch */
```

continued

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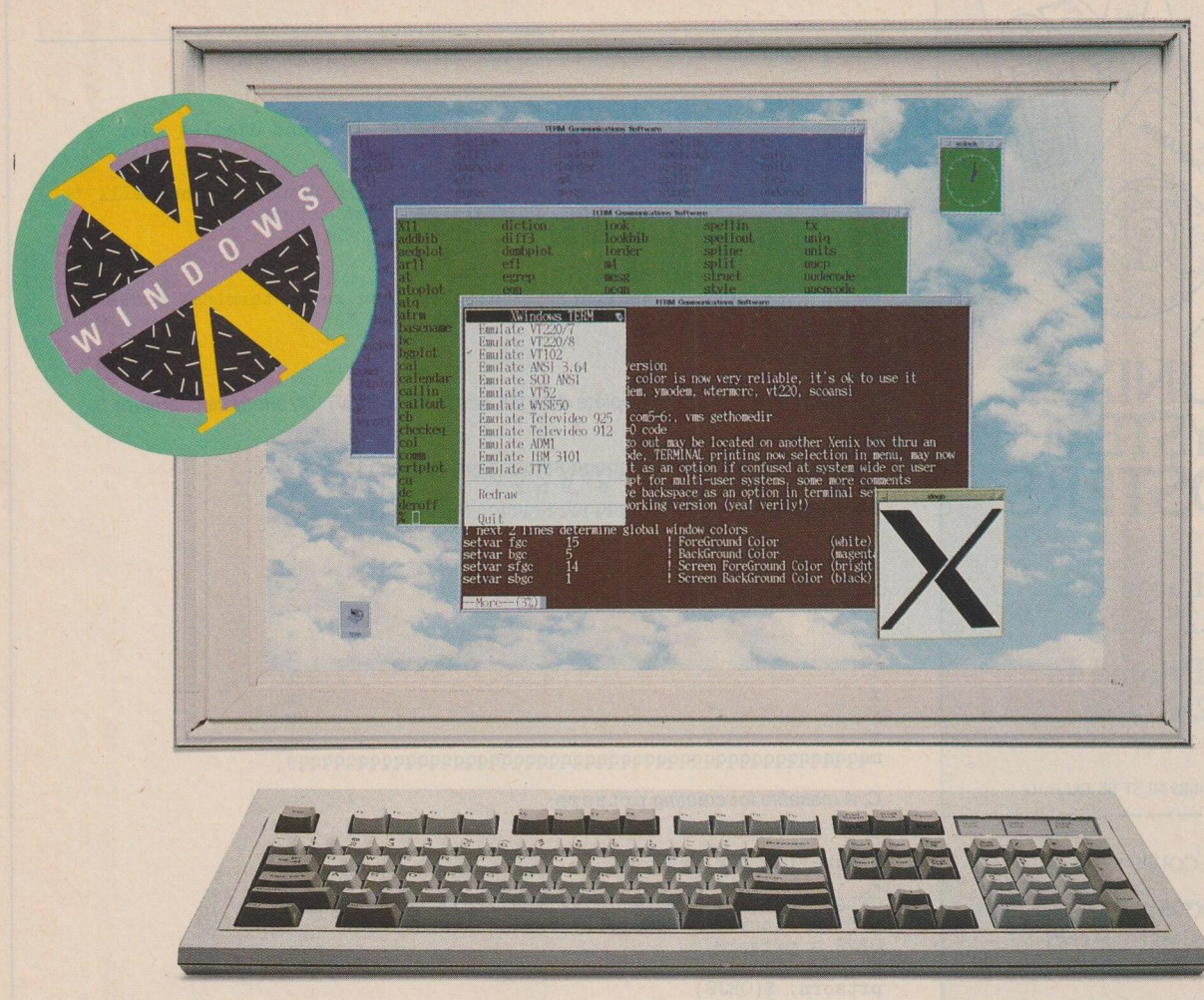

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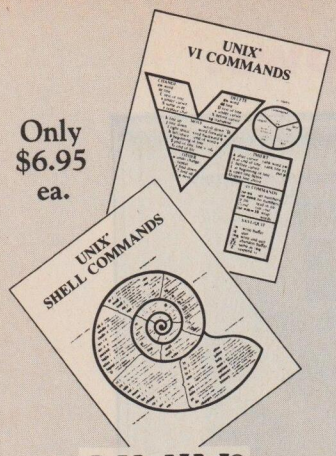

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Listing 1 continued

```
74                  }   /* end if */
75                  mvaddch(y, x, c);   /* move and display char */
76              }
77              x += 1; /* next char will be one column to right */
78              if (c == '\n') { /* if end of line next char will */
79                  x = 0;  /* start at first column */
80                  y += 1; /* on the next row */
81              }
82      }   /* end while */
83      refresh(); endwin(); /* display then reset terminal modes */
84      fclose(fp); /* close the input file */
85      exit(0);
86  }
```

B. Contents of a sample template data file, which uses the VT100 alternate character codes:

```
lqqq
```

Listing 1 continued

```
14      if (argc != 2) {
15          fprintf(stderr, "Usage: %s file\n", argv[0]);
16          exit (1);
17      }
18      if ((fp = fopen(argv[1], "r")) == NULL) {
19          perror(argv[1]);
20          exit(2);
21      }
22      initscr(); nonl(); noecho(); scrollok(stdscr, TRUE);
23      attron(A_ALTCHARSET);   /* enable alternate character set */
24
25      while ((c = getc(fp)) != EOF) {
26              if (c == TOGGLECHAR) {  /* toggle character sets */
27                  if (acs) {  /* if using alternate */
28                      acs = 0;    /* switch to standard */
29                      attroff(A_ALTCHARSET); /* disable alternate */
30                  } else {        /* if using standard */
31                      acs = 1;    /* switch to alternate */
32                      attron(A_ALTCHARSET); /* enable alternate */
33                  }
34                  c = ' ';    /* blank out togglechar */
35              }
36              if ((c != ' ') && (c != '\n')) {
37                  mvaddch(y, x, c);
38              }
39              x += 1; /* next char will be one column to right */
40              if (c == '\n') {  /* if end of line, next char will */
41                  x = 0;  /* start at first column */
42                  y += 1; /* on the next row */
43              }
44      }   /* end while */
45      refresh(); endwin();
46      fclose(fp); /* close the input file */
47      exit(0);
48  }
```

LISTING 2: Multiline records can be handled with standard UNIX utilities if they are converted first to single-line records. The appropriate sed command program provides a very efficient conversion utility for this purpose.

A. Listing of `mlinesort`*, which sorts a multiline data file:*

```
 1  :
 2  # mlinesort  Sort multiline records of varying lengths
 3  # Author: Susan Andarmani, January 1989
 4  # set -x    # Uncomment for debugging
 5  USAGE="Usage: $0 [-l sort-line-number] [filename]"
 6  # Process command-line options:
 7  sortline=1  # Set to sort first line by default
 8  if [ "$OPTIND" = 1 ]; then  # can use getopts
 9      while getopts l: arg
10      do
11          case $arg in
12              l)  sortline="$OPTARG" ;;   # reset line to sort
13              \?) echo $USAGE >& 2    # unrecognized option
14                  exit 1 ;;
15          esac
16      done
17      shift `expr $OPTIND - 1`        # shift over options
```

continued

Lines 37-45 process the data. The `(cat; echo)` command group passes the data to `sed` and appends a blank line to the input to delimit the last record. Then, `sed` automatically cycles through the input trying to apply the edit script to each line. You can modify `sed`'s behavior by addressing specific lines or patterns, or by using branching commands. The `-n` option tells `sed` not to print anything until it sees a `p` command.

On line 38, line 1 is addressed, so that `sed` will check the first input line and delete it if blank, because this would throw off the sort field count for the first input record. Whenever a line is deleted, `sed` automatically replaces it with the next one.

The next step is to convert the newlines within each record to colons as follows: The `N sed` command (line

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42) takes the next input line and appends it to the pattern space with its newline embedded. Then the subsequent substitute command (line 43) replaces any newline that precedes one or more non-newline characters in the pattern space with a colon. The `t` test (line 44) will cause control to pass to the label on line 41 if a substitution was performed. Note that this is a conditional "goto," or how you can get `sed` to perform a "loop." The loop stops when the blank line between records is seen; no substitution is done because the newline at the end of the record is not followed by any characters. Instead, control passes to line 45, which substitutes a colon for the last newline in the record and copies the pattern space to the standard output, which is piped into `sort`.

The data is sorted using a key beginning with the field specified in the `sortfield` variable and extending to the end of the line. Finally, `tr` translates all colons in the data stream to newlines to reconstruct the newline-delimited fields of the multiline records. To see exactly how `sed` formats the records, modify line 45 to insert a `tee` command (to display `sed` output on your screen) in front of the pipe to `sort`, as shown in Listing 2D.]

Sue Andarmani
Information Systems Member
AT&T
Sunnyvale, Calif.

The Security Hole

Because security is becoming more and more important to computer users, we are providing a minisection of this column devoted to UNIX system security contributions. Please look over the tools on your system and see if you have any that would meet or could be changed to meet our publication guidelines (see end of this column). Although we aren't publishing a security contribution this month, we're providing this notice to encourage our readers to submit security-related contributions.

Feedback

This section contains selected comments and contributions related to recent columns.

Tying Up a Loose End

Dear Dr. Thomas:

The `scpp` script published in your June 1990 column has a shortcoming that can be corrected easily. If you in-

Listing 2 continued

```
18  else    # getopts not available, so use manual approach:
19      while : ; do
20          case "$1" in
21              --) shift; break ;;
22              -l) sortline="$2" ; shift 2 ;;
23              -l*) sortline=`echo "$1" | sed 's/^..//'`; shift;;
24              *)  break ;;
25          esac
26      done
27  fi
28  # Process any remaining command-line arguments:
29  case $# in
30      0)  INFILE="" ;;    # no arguments so use stdin
31      1)  INFILE="$1" ;;  # take input from named file
32      *)  echo $USAGE >&2 # no more than one input file allowed
33          exit 2 ;;
34  esac
35  sortfield=`expr $sortline - 1`  # convert line to field number
36  # Process the data:
37  (cat $INFILE; echo) | sed -n '
38  1 {
39  /^$/d
40  }
41  : top
42  N
43  s/\n\(..*\)/:\1/g
44  t top
45  s/\n/:/p' | sort -t: +$sortfield | tr ':' '\012'
```

B. A sample data file used for input:

```
$ cat addressfile
John Doe
123 Main St.
New York, NY.  10021
212 555-1234

Henry Editor
444 Castro Street
Mountain View, CA. 94041
415 940-1500

Jane Doe
63 Cascade Dr.
Fairfax, CA. 94930
415 221-8649

$ □
```

C. Sorting the sample data by the fourth (phone number) line:

```
$ mlinesort -l 4 addressfile
John Doe
123 Main St.
New York, NY.  10021
212 555-1234

Jane Doe
63 Cascade Dr.
Fairfax, CA. 94930
415 221-8649

Henry Editor
444 Castro Street
Mountain View, CA. 94041
415 940-1500

$ □
```

D. You can add a `tee` command between the `sed` and `sort` programs to view the intermediate data for diagnostic purposes. Here's how to modify line 45 from Part A of this listing to do this:

```
s/\n/:/p' | tee /dev/tty | sort -t: +$sortfield | tr ':' '\012'
```

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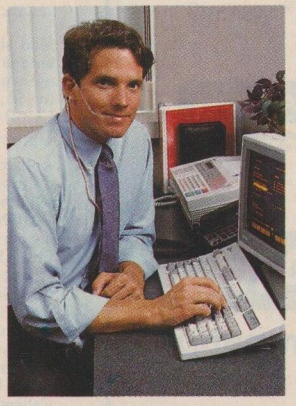

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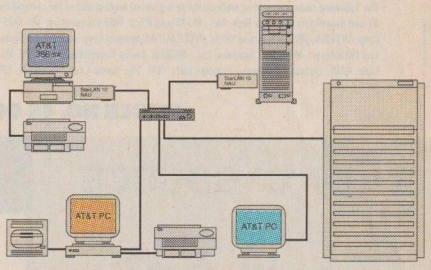

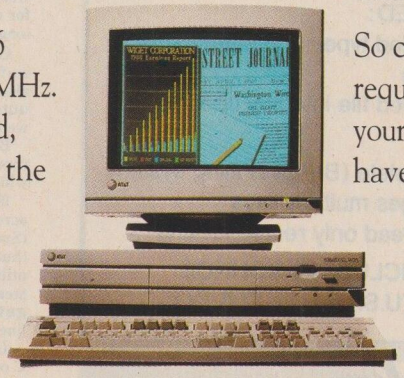

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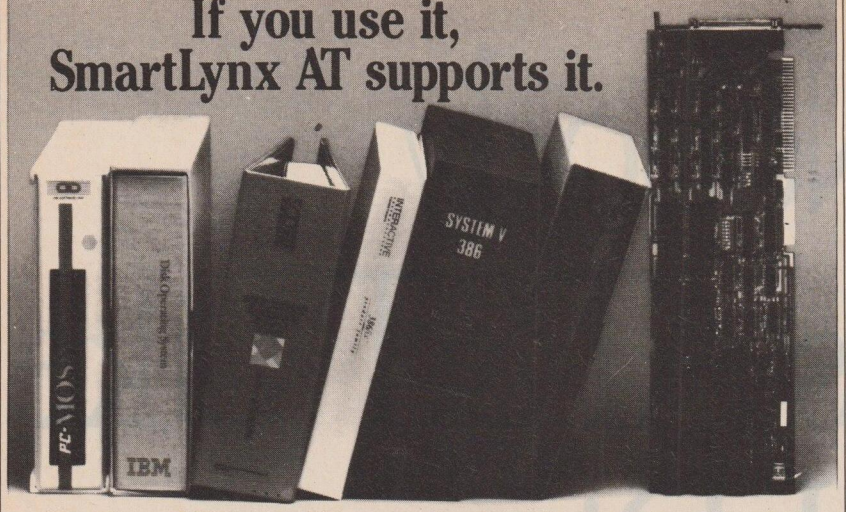

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voke this script with an argument such as "-D BSD1", the section of the source associated with "#ifdef BSD" is displayed because the variable `defined` contains the string "BSD", so it will trigger a match even though "BSD" is not the same as "BSD1". The problem is easily corrected using the associative array feature of `nawk`. Change line 45 to:

```
defined[ARGV[i]] = 1
```

lines 51 and 83 to:

```
if ($2 in defined)
```

and lines 57 and 88 to:

```
if (!($2 in defined))
```

to tie up this loose end.

Mike Tiller
St. Paul, Minn.

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Briefly describe the hardware and software environment (especially the UNIX system version) on which the contributed code was run.

If possible, you should write code that is portable across the popular versions of the UNIX system (System V.X, 4.XBSD, XENIX). Write Bourne or Korn (but not C) shell scripts and use universally available utilities, for example, `who am i` (all systems) instead of `whoami` (Berkeley only). If feasible, use `getopts(1)` or `getopt(3C)` to process command-line options and their arguments.

Use the standard I/O library for structured modular C code. Check source code for nonportable constructions with `lint`. Eliminate hardware dependencies, such as terminal control sequences. (Use `termcap` or `terminfo`.) Isolate nonportable code to one region or a separate module. Keep examples compact (under 100 lines of code with each line less than 65 characters long—counting tabs as 4 spaces) and explanations concise (under 400 words). Use `sed` instead of `ed` scripts, pipelines instead of intermediate temporary files, etc. Be succinct! □

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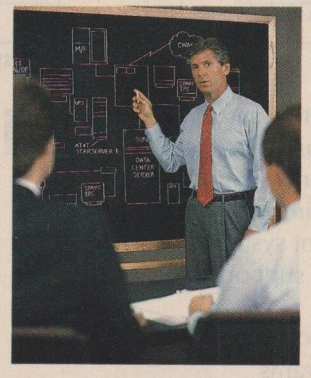

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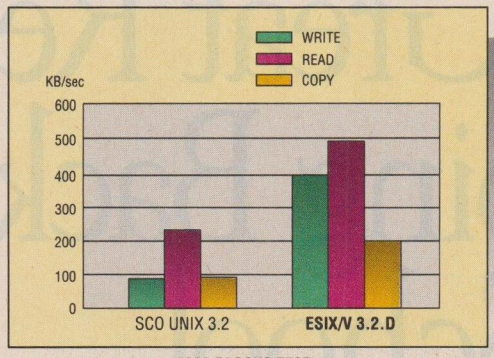

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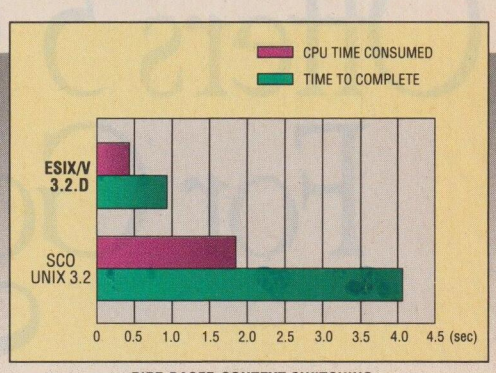

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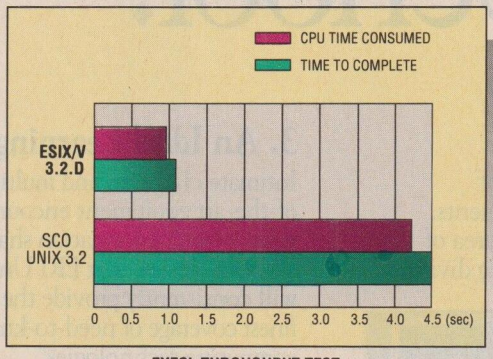

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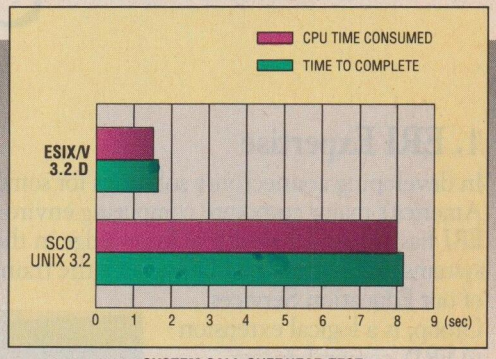

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CIRCLE NO. 124 ON INQUIRY CARD

Ray Swartz

SORT FILES, TEST NULL POINTERS, CHANGE THE ENVIRONMENT

This month's first question asks how to list all files in a directory tree sorted by size. We provide a shell program to postprocess `ls -Rs` output to generate this report. The second question asks if a particular test comparing a pointer to null is portable. Portability is guaranteed if you use the proper test expression. The last question asks if it's possible to change the environment of a parent process. The answer is no, but we develop a utility you can use to change the environment of a process as you invoke it.

Sizing Up the Files

Question: Our systems seem to be in a constant need for more disk space. As a believer in the "80/20" rule (80 percent of the disk space is consumed by 20 percent of the files), I would like to get a listing of all the files in and below a directory, sorted by file size. Do you know a command that will provide this report?

Willard Carlson
Nyack, N.Y.

Answer: No single utility distributed with the UNIX system generates such a report, but you can easily create a shell program that will provide the desired information. However, the first step is to clarify what you mean by the term "file size."

The `ls` command displays file sizes in two ways: The `-s` option causes `ls` to list file size in blocks (System V `ls` makes a report in terms of 512-byte blocks, BSD 1024-byte blocks), and the `-l` option has `ls` report the total character count for a file. Because your interest is in relative file size, I suggest you use blocks, because they are easier to interpret. Listing 1A shows some sample output from `ls -s`.

We show two ways to write a script to list files by size. The first is more streamlined, but System V-specific, and the other is a less elegant, but more universal, version. What makes the System V version non-portable is the use of the `xargs` command, which is only distributed with recent AT&T-derived UNIX and XENIX systems.

The pipeline, shown in Listing 1B, calls `find` to output (`-print`) all the ordinary files (`-type f`) in and below a specified starting directory (represented by *start-dir*). These are sent to `ls -s` (via `xargs`), to determine their sizes in blocks. Then, the files are sorted from largest to smallest with `sort -r`.

The `xargs` command is needed to buffer the arguments sent to `ls -s`. The shell can only handle a preset number of characters on a single command line (generally around 5,120). Because `find` may produce more arguments than can be handled by the shell, `xargs` is called in to moderate. It reads lines from its standard input and runs the listed command (in this case, `ls -s`) when an internal buffer gets filled. And, `xargs` continues to read arguments from the standard input and execute the listed command until the standard input is closed.

Because the easy solution is not portable, I decided to write a portable version that doesn't depend on `xargs`. Instead of using `find` to locate all the files in and below a directory, I use `ls -Rs` to generate a list of files and their sizes. While this works, `ls -Rs` also produces some extraneous output, which must be handled.

continued

LISTING 1: The sizes of all files in and below a directory can be created by processing the output of ls -Rs with a pipeline.

A. Sample `ls -s` *command output:*

```
$ ls  -s
total 14
   2 Testdir
   2 c.question
   2 file.size.q
   2 fsck.q
   2 login.q
   4 rcd.q
$ □
```

B. The System V pipeline to list sizes of files in a directory tree (starting at start-dir*):*

```
find start-dir -type f -print | xargs ls -s | sort -r
```

C. Sample `ls -Rs` *command output:*

```
$ ls  -Rs
total 14
   2 c.question
   2 file.size.q
   2 fsck.q
   2 login.q
   4 rcd.q

Testdir:
total 44
  40 rename
   4 rename.c
$ □
```

continued

Besides listing files and their sizes in the current directory, `ls -s` also summarizes the total blocks used by the files in this directory (see Listing 1A). The first "total" line is the summary, which is followed by an alphabetical listing of files and their sizes.

However, `ls -s` only lists files in the current directory, but you can use the `-R` (recursive) option to have `ls` search in all subdirectories (see Listing 1C). We'll use the `ls -Rs` command to provide the raw data for your report and postprocess its output to sort by file size.

You can't simply pipe the output of `ls -Rs` into `sort` because the data is not uniform. In fact, four types of data are output by `ls -Rs`: a block size followed by a file base name, one "total" line per subdirectory, the relative path name of each subdirectory, and a blank line separating directories.

So, before sorting we'll have to remove the "total" and blank lines and deal with the subdirectory names. The "total" lines are easily removed with

Listing 1 continued

D. A pipeline used in the `fsize` script:

```
ls -Rs | sed -e '/^total/d' -e '/^[^ ].*:$/s/://'
```

E. Listing of the `fsize` script:

```
:
# @(#) fsize  Recursively display files sorted by size
# Author: Ray Swartz, September 1990
USAGE="Usage: $0 [ directory ]"
case $# in
    0) ;;
    1) if [ ! -d "$1" ]; then
           echo "$1 is not a directory" >&2
           echo $USAGE >&2 ; exit 1
       else
           cd $1
       fi ;;
    *) echo $USAGE >&2
       exit 2 ;;
esac
ls -Rs | sed '/^total/d
             /^[^ ].*:$/s/://' |
awk 'BEGIN { path = "'`pwd`'"
             if (path == "/")
                 path = ""
             dir = path  }
     NF == 1 { dir = path "/" $0 }
     NF != 1 { name =  dir "/" $2
               printf "%5s %s\n", $1, name }' |
sort -r
```

continued

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the `sed '/^total/d'` command. Blank lines will be ignored later on in the script by `awk`. You can't simply delete the subdirectory names without generating an ambiguous report because `ls -Rs` only prints base names, not full path names. Instead of deleting the subdirectory names, you should use them to build full path names from the file base names, which can be done with some set-up work by `sed` and formatting with `awk`.

First, use `sed` to remove the colon at the end of each subdirectory name. Because the first character of a subdirectory name always begins a line and a colon follows the name, you can use the command `sed /^[^ ].*:$/s/:$//`, which edits all lines that don't begin with a space but do end with a colon. The pipeline in Listing 1D shows the `ls -Rs` and `sed` commands discussed here.

Converting `ls -Rs` file base names into full path names is a little tricky. First, get the path for the current directory (use `pwd`). Second, prefix the current path to the base name. Because subdirectory names are listed relative to the current directory, a full path consists of the current directory path name, the subdirectory base name, and the file base name. The first two are constant within a single subdirectory. When a new subdirectory is found (using a search pattern similar to the one used in the `sed` command shown above) then that subdirectory name is used.

Listing 1 continued

F. Some sample output when using the `fsize` script:

```
$ fsize
  40 /usr/ray/Uw/Columns/1991/Testdir/rename
   4 /usr/ray/Uw/Columns/1991/Testdir/rename.c
   4 /usr/ray/Uw/Columns/1991/rcd.q
   2 /usr/ray/Uw/Columns/1991/c.question
   2 /usr/ray/Uw/Columns/1991/file.size.q
   2 /usr/ray/Uw/Columns/1991/fsck.q
   2 /usr/ray/Uw/Columns/1991/login.q
$ □
```

Listing 1E shows the completed `fsize` script. Lines 5-15 process the optional directory command-line argument. After changing to the requested directory (line 11), line 16 pipes `ls -Rs` output into `sed`, which removes the "total" lines and the colon appended to the subdirectory names. The result is piped into the `awk` program encompassing lines 18-24, which completes the formatting.

Line 18 stores the current directory path name in `path` and line 19 tests if

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LISTING 2. There are differences between computers that might cause portability problems when comparing pointers to the null pointer.

A. Here is the code fragment in question:

```
1  struct xxx *ptr;
2
3  ptr = (struct xxx *) 0;
4  if (ptr) { /* code to run for non-null pointer */
```

B. A program to test portability:

```
1  main()
2  {
3      struct xxx {
4         int a;
5         int b;
6      } *yyy;
7
8      yyy = (struct xxx *) 0;
9      if (yyy == 0)
10         (void)printf("yyy tests as 0\n");
11     else
12         (void)printf("yyy doesn't test as 0\n");
13     return(0);
14 }
```

the starting directory is /. If it is, `path` is left blank (line 20) to avoid // at the beginning of paths. Line 21 sets the temporary variable `dir` to `path`'s value. Line 22 generates full path names for subdirectories and line 23 handles file name and size lines, converting file base names into path names. Finally, line 24 prints the file block size, followed by the path name. This is piped to `sort` (line 25), which sorts the result in descending block size order. Listing 1F shows some sample output.

[*Editor's note:* If you have the sysadm System V Administration menu system, as superuser you can list files sorted by size using the "filesize" selection.]

A Portable Structure

Question: I want to write C code that works for any ANSI or K&R C compiler in any environment (UNIX, non-UNIX, non-Posix, etc). Is the code shown (see Listing 2A) safe? What worries me is that a run-time pointer to which I have assigned null does not, on some systems, have a bit pattern of all zeros. Thus, I am concerned that simply testing `ptr` might not evaluate to false (represented by zero in C) on such systems.

David Eaglesfield
Cambridge, Mass.

Answer: It's true that a null pointer is not always represented as all zero bits because the actual representation of a null pointer on a specific system is under the control of the local C compiler. The issue, as you state it, is do these "non-zero" null pointers equate to false?

To ensure that the if test works properly on all C compilers, extend it to explicitly compare the pointer against zero, that is, `ptr != 0`. By including the constant zero in the expression, you bring C's default promotion rules into play, guaranteeing that the integer zero will be promoted into the equivalent pointer value. Thus, I suggest that you use `if (ptr != 0)` instead of `if (ptr)` as your test.

This approach is portable because it uses C's promotion rules to guarantee portability. I have tested the code in Listing 2B on both ANSI and K&R compilers and it compiles without any warnings and works properly. Also, `lint` doesn't complain about any non-portable constructions.

The program in Listing 2B is an example of the code described here. Lines 3-6 declare a structure with tag name `xxx` and define a pointer to this structure named `yyy`. In line 8, `yyy` is assigned a null pointer. (The cast is necessary to convert zero into a null `struct xxx` pointer.) Lines 9-12 test

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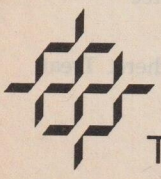

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the value of `yyy` and display the result.

A Fragile Environment

Question: I'd like to set a new environment variable, or to change an existing one (for example, `PATH`), from a C program. I don't want to create a new shell process, but do want to make the changes in the parent process. Is it possible to write such a program?

Ivica Crnkovic
Vasteras, Sweden

Answer: There is no way a child process can change the environment of its parent process. Thus, on the surface, the answer to your question is no. However, it is possible to change a program's environment while it is executing.

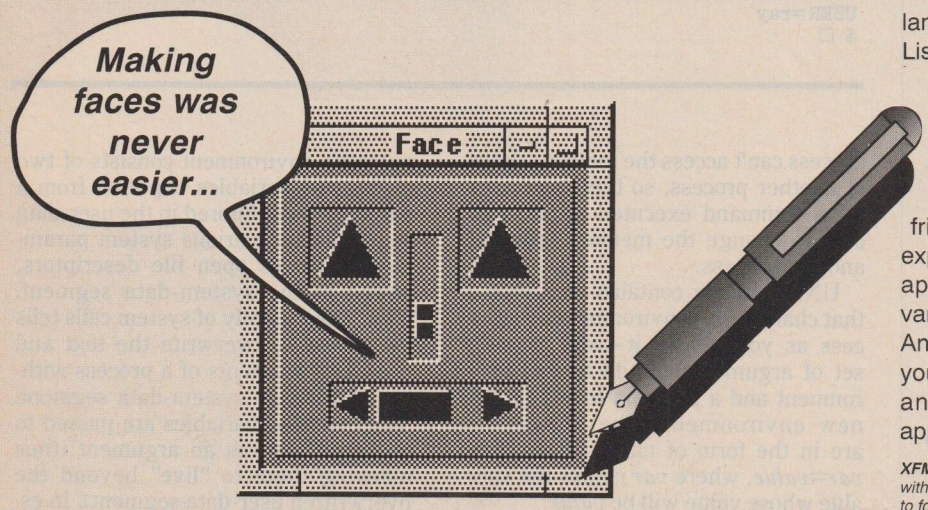
Before we start, let's take a quick look at how UNIX creates processes. When you execute a command (that isn't built into the shell), a new shell process is created to run it. With the exception of shared memory IPC, one

LISTING 3. While one process cannot change the environment of another process, a program can change its own environment and then "exec" another program. We provide the `defenv` program to accomplish this task.

A. Listing of the `defenv` *program:*

```
1  #include <stdio.h>
2
3  main(argc, argv)
4  int argc; char *argv[];
5  {
6      char *execprog;
7
8      if (argc < 3) {
9          fprintf(stderr, "Usage: %s prog var=value ...\n", argv);
10         exit(1);
11     }
12     execprog = *++argv;
13     argc--;
14     while (argc-- > 1) {
15         if (strchr(*++argv, '=') == NULL) {
16             fprintf(stderr, "%s: No = in %s\n", *argv);
17             exit(1);
18         }
19         putenv(*argv);
20     }
21     execlp(execprog, execprog, (char *)0);
22     perror(execprog);
23     exit(2);
24 }
```

continued



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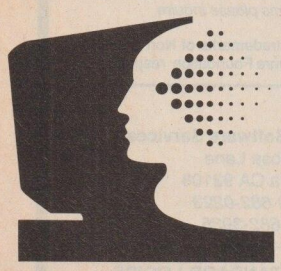

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Listing 3 continued

B. Listing of the `testenv` *shell script:*

```
 1  case $# in
 2       0) ;;
 3       1) echo "\nBefore:\n"
 4          env
 5          exec defenv $0 ARGS="$1" ;;
 6       *) echo "Too many arguments"
 7          exit 1 ;;
 8  esac
 9  echo "\nAfter:\n"
10  env
```

C. The `testenv` *script in action:*

```
$ testenv test

Before:

HOME=/home/ray
SHELL=/bin/sh
EDITOR=/usr/ucb/vi
LOGNAME=ray
USER=ray
TERM=ansi
PATH=/usr/bin:/bin:/usr/ucb:/usr/ray:.

After:

ARGS=test
EDITOR=/usr/ucb/vi
HOME=/home/ray
LOGNAME=ray
PATH=/usr/bin:/bin:/usr/ucb:/usr/ray:.
SHELL=/bin/sh
TERM=ansi
USER=ray
$ □
```

process can't access the memory space of another process, so there's no way for a command executed in one process to change the memory space of another process.

UNIX already contains a command that changes the environment of a process as you invoke it—`env` takes a set of arguments to add to the environment and a program to run in this new environment. The arguments are in the form of name-value pairs, *var=value*, where *var* names the variable whose value will be *value*.

Your question indicates that you have a specific application in mind. Thus, instead of simply pointing you to `env`'s documentation, I have written `defenv`, which is almost equivalent to `env`, but shows you one way to write a command that changes its environment without running a new process.

However, before describing `defenv`, I want to provide more background. A process consists of three parts: text, user-data, and system-data. The executable code is stored in what is often called the text part of the process. The process's environment consists of two pieces: the variables exported from a parent process (stored in the user-data segment) and various system parameters, such as open file descriptors, stored in the system-data segment. The "exec" family of system calls tells the kernel to overwrite the text and user-data segments of a process without altering its system-data segment. The exported variables are passed to an "exec" call as an argument (thus allowing them to "live" beyond the overwritten user-data segment). In essence, an "exec" call changes the identity of a process without changing that process's environment.

Thus, you can change the environment of the current process by the proper use of an "exec" call: execute your environment-changing program without creating a new process. In this way, the changes to the environment stay in the current process.

However, once you "exec" a program, you lose the original text segment and user-data the process was running. To run a command that changes a process's environment re-

quires two steps. First, you "exec" the program that makes the changes you want. Second, you "exec" the desired program so that it operates in the new environment.

Each step requires a program—the one that changes the environment and the target program whose environment you wish to change. Our example of the first program (named `defenv`) takes at least two arguments: the target program to invoke and one or more variables to place into the execution environment of the invoked process. The environment arguments passed to `defenv` must be in the form *var=value*.

The heart of `defenv` is the `putenv()` library routine (line 19), which places variables into a process's environment. The arguments for this call use the form *var=value*. Note that `putenv()` is not available on BSD, nor older XENIX or System V implementations.

Our `defenv` program stores the name of the program to invoke in `execprog` (line 12) and then decrements `argc` (line 13) to ready for processing the next argument. The while loop encompassing lines 14 to 20 check that an argument contains an assignment operator (=), and, if so, puts that variable definition into the environment. Otherwise, an error message is printed and the program exits. After all the arguments have been processed, `defenv` attempts to "exec" the program identified by the first argument (line 21). If it fails, an error message is displayed (line 22) and the program terminates.

The `testenv` shell script, shown in Listing 3B, demonstrates how `defenv` can be used. This script places its single invocation argument, which is stored in the shell variable `ARGS`, into the environment by "execing" `defenv` (line 5) to run another instance of this script. Note that if `testenv` is run without arguments, it simply prints its environment. Listing 3C shows an example of using `testenv`. □

Guidelines: Obviously, this column won't be of much interest unless you send us your questions. Try to make your questions as general interest as possible, and, please, no questions regarding specific hardware or third-party application packages. State the UNIX system version, if applicable, for the question at hand. Send your questions to Ray Swartz, "Answers to UNIX," c/o UNIX WORLD magazine, 444 Castro St., Mountain View, CA 94041. Or send them via e-mail to:

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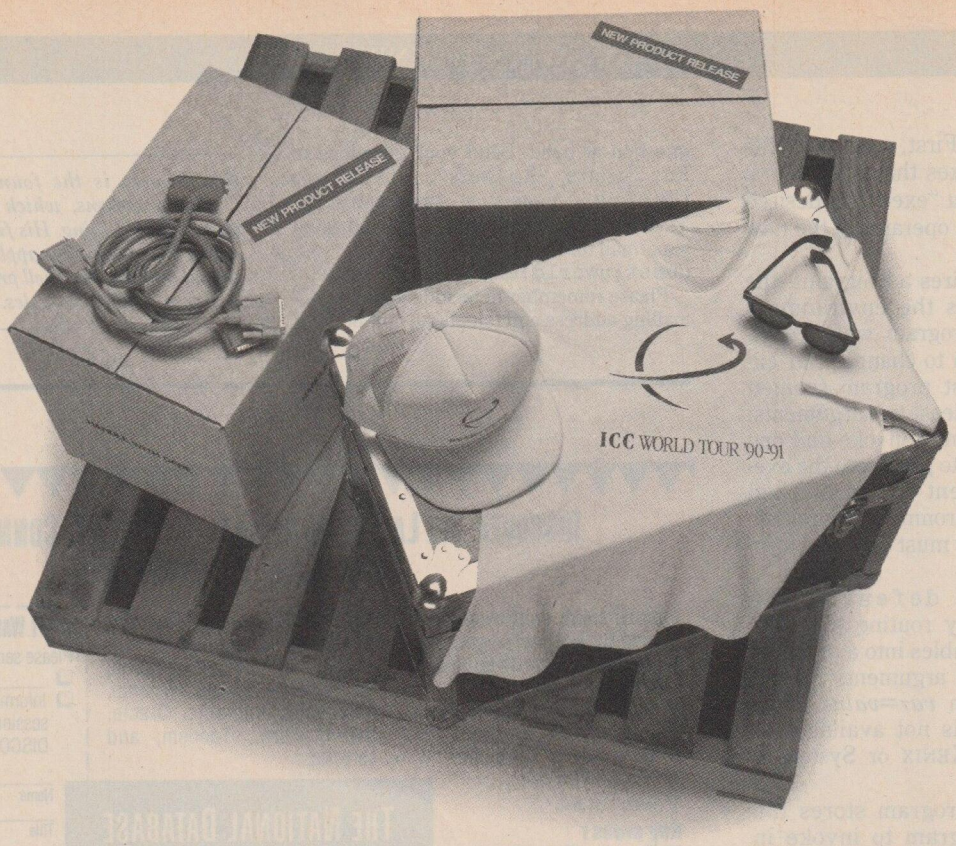

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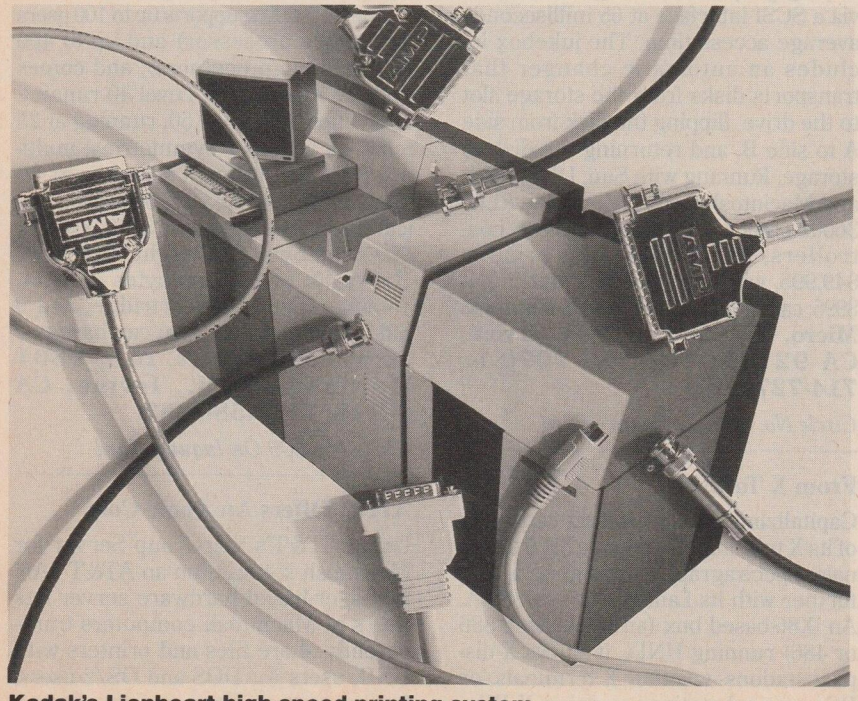

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Using a $5,000 Next computer as a terminal for accessing an IBM mainframe may not make sense financially, but at least it's possible. Avatar's InSession 3270 for Next lets you link the two, while the Next Programmer's Toolkit provides instructions on how to develop connectivity applications. With InSession 3270, you can have direct coaxial connectivity through the SCSI port of the Next machine and into the IBM control unit on the mainframe. The software also includes application software for other IBM SNA services, including terminal emulation, session configuration, file transfer, copy and paste functions, and keyboard remapping.

Avatar's Programmer's Toolkit helps you build applications using the Next Interface Builder and InSession 3270, giving access to the C and Objective C languages, in addition to the Next Speaker/Listener development tools. Cost is $1,295. **Avatar, 65 South St., Hopkinton, MA 01748; 508-435-3000.**

Circle No. 305 On Inquiry Card

Here Comes the Sun

Sun Microsystems' SPARCstation VX and MVX board-level visualization accelerators are designed to boost the performance of SunVision applications by 2 to 15 times, delivering high performance across a wide range of visualization techniques, including image processing, volume rendering, 3-D graphics, and high-quality rendering. On a single board, the VX has a 32-bit processor, program memory, and two accelerated frame buffers (a 16-megabyte, 32-bit frame buffer for image display, and an 8-bit GX frame buffer for display of Sun's OpenWindows). The VX integrates the output of the two frame buffers for display on a single, high-resolution (1280-by-1024 pixel) 21-inch monitor.

Additional performance is available by adding the MVX multiprocessor board to VX systems. Encompassing 32-bit processors, each with 4 megabytes of memory, the MVX, together with the VX, transfers data over a high-speed bus that operates at 320 megabytes per second. Prices for two SPARCstation-based versions of the VX systems are $55,900 (for a SPARCstation 330VX) and $86,900 (for a SPARCstation 470VX). As an add-in option for deskside SPARCstations and high-end SPARCservers, its price is $24,000. The MVX can be added to a VX workstation for $30,000. **Sun Microsystems, 2550 Garcia Ave., Mountain View, CA 94043; 415-960-1300.**

Circle No. 306 on Inquiry Card

Now You Can Erase 36 Gigabytes of Data

Pinnacle Micro's new REO-36000 jukebox holds up to 56 5 1/4-inch rewriteable optical disk cartridges, for a total of 36 gigabytes of storage accessible via a SCSI interface at 65 milliseconds average access time. The jukebox includes an automatic changer that transports disks from the storage slot to the drive, flipping the disk from side A to side B, and returning the disk to storage. Running with Sun, DEC, IBM, and Macintosh workstations, the REO-36000 comes with device drivers, controllers, and cables. List price is $49,995, with interface kits starting at $995; cartridges are $250 each. **Pinnacle Micro, 15265 Alton Pkwy., Irvine, CA 92718; 800-553-7070 or 714-727-3300.**

Circle No. 308 On Inquiry Card

From X To IBM

Capitalizing on the existing capability of its X terminals to emulate 3270 terminals, Spectragraphics has gone a step further with its LanSet Gateway/SNA. An iX86-based box (an Intel-based 386 or 486) running UNIX, it allows X display stations–whether X terminals, or PCs or workstations running X Windows–to access IBM SNA-based hosts. The X Window-based machines connect to 3270, 3278, or 3279 applications on the host (the latter two are graphics-based), and each can run in a separate window on a single screen. Other PCs and terminals can access IBM hosts through the LS Gateway/SNA through telnet.

The gateway encompasses a 1.2-megabyte, 5 1/4-inch floppy drive, an internal hard drive, 8 megabytes of RAM, an Ethernet LAN card, configuration and diagnostic software, and an SDLC access card; it also supports IBM's NetView network monitoring system. Cost is $12,500 for a 16-user system and $16,500 for a 32-user system. **Spectragraphics, 9707 Waples St., San Diego, CA 92121; 619-450-0611.**

Circle No. 307 On Inquiry Card

DRS Orders

ICL's new servers run UNIX System V.4 and target OEMs (original equipment manufacturers) in the multiuser UNIX market: the i486-based DRS 3000, and the SPARC-based DRS 6000. The DRS 3000 supports up to 32 users and encompasses five EISA slots for network interface, communications, and peripheral controller cards. Prices for the DRS 3000 start at $30,000, including 8 megabytes of RAM, 330 megabytes of hard disk storage, a 150-megabyte tape cartridge, a 1.44-megabyte disk drive, and eight 5 1/4-inch half-height bays.

The DRS 6000 supports up to 100 users (for single processor) and up to 400 (for multiple processors), and comes in three models: the Level 40 running at 17 mips, the Level 50, running at 23 mips, as well as a symmetrical multiprocessing platform running at 60 mips. Prices for the DRS 6000 for a typical configuration start at $130,000: two 600-megabyte full-height drives, 16 (Level 40) or 32 megabytes of RAM, 150-megabyte tape cartridge, and 9 full-height bays, and you can have two expansion cabinets. **ICL, 9801 Muirlands Blvd., Irvine, CA 92718; 714-458-7282.**

Circle No. 309 On Inquiry Card

AT&T Offers An Apple Core

Using AT&T's StarGroup Server for Macintosh software on an AT&T LAN Manager-based hardware server lets users at Macintosh computers transparently share files and printers with UNIX users (or DOS and OS/2 users, for that matter). Users can access data-

base applications, for instance, by any of the four operating systems and share the same server-based script and/or data files without modifications.

The server software supports AppleTalk Filing Protocol 2.0 and AppleTalk Printer Access Protocol (PAP) so that you don't need additional Macintosh software. The file server itself can also function as a remote hard disk for either extra storage or backup of user's local files. Hardware required is either a 386-based AT&T PC or StarServer E mini, with 8 megabytes of RAM and a 135-megabyte hard disk. Cost for eight users is $795, or $1,295 for unlimited user access. **AT&T American Transtech Direct Marketing Service, 8000 Bay Meadows Way, Jacksonville, FL 32256; 800-247-1212.**

Circle No. 310 On Inquiry Card

UPS, Don't Fail Me Now

American Power Conversion's new Smart-UPS 400 standby power system features an automatic battery self-check, so that you can check to see that you have sufficient battery power before the electricity fails, rather than after. In addition to the automatic battery check, the Smart-UPS 400 features sine-wave output, surge suppression, noise filters to protect data, diagnostics to determine poor ground and reversed polarity in your site's wiring, and built-in meters to determine equipment capacity and voltage level emitted from your wall outlets.

Designed to fit easily under the monitor of a PC running SCO UNIX, the Smart-UPS 400, with 400 volt-amps of battery backup, can keep a typically configured system up and running for about 15 minutes after a power failure. List price is $499. **American Power Conversion, P.O. Box 278, 132 Fairgrounds Rd., W. Kingston, RI 02892; 401-789-5735.**

Circle No. 311 On Inquiry Card

Expedient, Expandable Graphics

RasterOps Corp.'s 8S and 24S color graphics boards provide 8-bit and 24-bit hardware support for the Apple 13-inch monitor or compatibles with 640-by-480 pixel resolution. The new boards incorporate the RasterOps custom chip technology developed for its large-screen display systems, the 8L and 24L. Supporting the Apple standard of block mode data transfer, the hardware allows moving graphics across the NuBus up to 600 percent faster when used with the RasterOps Accelerator. The boards feature pan and zoom hardware, and extended pixel resolution to 2046-by-512. Price for the 8S board is $695; sold only as a package with RasterOps' Accelerator, the 24S costs $1,195. **RasterOps, 2500 Walsh Ave., Santa Clara, CA 95051; 408-562-4200.**

Circle No. 312 On Inquiry Card

Expanding Network Options

SBE's IPM-ENET and IPM-SCSI daughterboard modules plug into the 68020-based VMEbus single-board computer to expand the unit's networking capabilities in real-time data processing and industrial control applications. The IPM-ENET enables the VPU-25 computer to access host computers or other devices on an Ethernet LAN; the IPM-SCSI gives the VPU-25 the ability to transfer data to tape, Winchester, or floppy drives. The VPU-25 offers on-board 20- or 25-MHz microprocessors, 1 or 4 megabytes of DRAM, up to 1 megabyte of EPROM, and an optional 68882 floating-point coprocessor. Ports supported are asynchronous, X.25, HDLC, SDLC, or bisynchronous. Price for the IPM-ENET is $250 in quantities of 100; for the IPM-SCSI, is $205 in quantities of 100. **SBE Inc., 2400 Bisso Lane, Concord, CA 94520; 415-680-7722.**

Circle No. 313 On Inquiry Card

Thoroughly Modern Modem

Designed to overcome connection and transmission problems caused by poor quality lines encountered with rural, cellular, satellite, and international links, Microcom's QX/4232hs (for high speed) modem supports the CCITT V.42/V.42bis standard. With data transfer speeds up to 38.4 kilobits per second, the QX/4232hs offers two methods of data compression: Microcom Networking Protocol 5 and V.42bis. Other features include automatic log-in, transparent password comparison, and remote access capability for users of UUCP and the Kermit protocol. Price is $1,099. **Microcom Inc., 500 River Ridge Dr., Norwood, MA 02062-5028; 800-822-8224 or 617-551-1000.**

Circle No. 314 On Inquiry Card

A Rainbow Within Reach

Targeting fast graphics and fast scrolling speeds, Pixelworks' Rainbow Graphics video controller incorporates a digital signal processor running at 10 mips, pixel memory on one-megabit video RAM chips, and a bitblit accelerator for high-speed capabilities. Available for AT- or EISA-based machines, the controller supports 1280-by-1024 or 1024-by-768 resolutions, and can be set up in single- or dual-monitor configurations. With eight bitplanes (256 colors) and two optional overlay planes (3 overlay colors in all), the boards are also available in a 16-bit double-buffered configuration. OEM prices start at $995. **Pixelworks Inc., 7 Park Ave., Hudson, NH 03051; 800-247-2476 or 603-880-1322.**

Circle No. 315 On Inquiry Card

Halt–Who Goes There?

Implementing the Defense Department's guidelines for security password management, Unitech's Upass password control software gives administrators greater control over their systems' security and automatic reporting procedures that are transparent to end users. Using Upass, you can set up a system to make existing log-in procedures meet Defense Department standards. The software stores passwords as encrypted data, so they can be viewed in a system-maintained database (this also means forgotten passwords can be recreated and user numbers can't be reassigned, other than to their original name).

As an administrator, you can be notified of attempts to penetrate the system in real-time, as well as repeated unsuccessful attempts to log in, and attempts to log in from a computer not authorized for a given user's name. Part of Unitech's Usecure security software, Upass runs on DEC, Sun, HP, Unisys, NCR, and other UNIX platforms. Prices for Upass and Usecure range from $1,000 to $4,000, depending on CPU size classifications and UNIX versions supported. **Unitech Software, 1800 Alexander Bell Dr., Reston, VA 22091; 703- 264-3301.**

Circle No. 316 On Inquiry Card

Give 'Em The Axcess

Running on an iX86-based PC, Atlantix's Axcess software is UNIX-based LAN Manager server software that lets you link UNIX, DOS, OS/2, and Macintosh computers. Through the PC-based server, users can transparently access files, applications, and peripherals from all computers' native environments; file

ADVERTISER'S INDEX

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UPCOMING SHOWS

6th Annual EP, Professional Electronic Publishing and Commercial Electronic Prepress Technology Conference: January 21-23
This conference continues its focus on bridging the gaps between Japanese automation techniques for print production and those used by the western world. Entitled "Electronic Integrated Processes for Print-EIP in Action," the conference promises an agenda with a range from Japanese PostScript to the newest technologies from east and west. Held in conjunction with the conference will be the Business Development Assistance Program (BDAP), January 18-26, which will offer answers and insights to businesses seeking to form strategic alliances with companies in Japan. The areas of assistance available through the program include technology transfers, OEM agreements, distribution networks, market niche analysis for products and technologies, joint ventures, mergers, and acquisitions. The conference and program will be held at the Forum Club, Tokyo, Japan. Contact Tim Bolton, Dunn Technology, 619-758-9460.

The Know Show '91: January 22-24
Co-sponsored by the Greater Cleveland Chapter of the National Computer Graphics Association and the Printing Industries Association of Northern Ohio, The Know Show is a regional exhibition on printing, graphics, communications technologies, and computer graphics. In addition to exhibits from such companies as Apple Computer and Hewlett-Packard, the show will include seminars by the Graphic Arts Council and the Greater Cleveland Chapter/National Computer Graphics Association. The show will be held at the Cleveland Convention Center, Cleveland, Ohio. Contact Todd Romanski, Xpoco inc., 216-621-3144.

NetWorld 91: February 11-14
Delivering NetWorld 91's keynote address, "The Synergy Between Open Systems and Networking," is E.W. "Bud" Huber, chairman of the User Alliance for Open Systems and manager of advanced networks integration of Hughes Aircraft Company, Long Beach, Calif. The Alliance is looking to overcome barriers to widespread implementation of open systems information technology. The organization is comprised of end users of large information technology systems. The event will also feature the NetWorld Seminar Series and tutorials.

NetWorld 91 is an international networking and connectivity trade show serving the purchasing, educational, and marketing needs of the industry. Network communications managers, engineers of technical services, MIS/DP directors, systems analysts, and data communications planners are scheduled to attend. More than 20,000 attendees are expected to see the exhibits of 300 vendors. The conference will be held at the John B. Hynes Convention Center, Boston, Mass. Contact Mark Haviland, Bruno Blenheim, Inc., 800-444-EXPO or 201-569-8542.

DEXPO Canada: February 19-21
Held in conjunction with the DECUS (the international association of DEC users) Symposium/Canada, DEXPO provides a forum in which DEC users can examine products, explore options, and find solutions from vendors of networked multivendor systems. The show aims to facilitate purchasing decisions of DEC-compatible products and services such as personal computing software and hardware, database management, display terminals, communications interfaces, modems and multiplexers, engineering workstations, disc/tape drives, and printers/plotters. The conference will be held at the Palais des Congres, Hull, Quebec, Canada. Contact Sharon Healy, Miller Freeman Expositions, 617-232-3976.

The Seventh IEEE Conference on Artificial Intelligence Applications: February 24-28
The IEEE conference is focused on the application of artificial intelligence techniques to real-world problems. It includes case studies of knowledge-based application solutions to significant problems and stimulates the development of useful techniques. The conference will consist of three tracks: the "Scientific/Engineering" applications track, which covers the general area of industrial and scientific applications; the "Business/Decision Support" applications track for decision support applications in business, government, law, etc.; and the "Enabling Technology" track, which fo-

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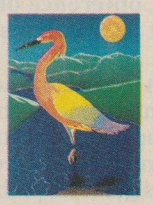
If you're not using Tek's color printers, take a hike.

If you're printing from a workstation in your office but your printer's still down a far-off hallway, then you've got a long way to go.

But now Tektronix has two Ethernet TCP/IP color 300-dpi printers. So sit down and take a load off.



The 4693 PXN is a color PostScript-language compatible printer, while the 4693 DXN is a color raster printer. Both use the thermal wax transfer technology that has made our color so graphic and bright for the last eight years.

The 4693 DXN quickly and easily connects anywhere on your network, on thick or thin wire, utilizing BSD 4.3 lpr spooling. The 4693 PXN connects the same, and has additional simultaneous RS232 and AppleTalk ports.

These printers support HP-GL, XWindow, Sun OpenLook, SGI raster and other formats, not to mention your arches. And both are available at obtainable, realistic prices.

Tektronix' 4693 PXN and 4693 DXN Ethernet network color printers. Now that calls for a standing ovation. For more information call 1-800-835-6100, Dept. 5U; e-mail us at color_printers@tek.com or fax a message to 1-503-682-3408.

Tektronix®

The best and the brightest.

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and record locking is supported across all systems. Axcess also provides remote administration and network diagnostic capabilities.

Axcess supports Ethernet (twisted-pair or coax), token ring, and StarLAN, and up to 255 concurrent users per server; it's also interoperable with Atlantix's CocoNet XENIX-based server software. Priced at $4,595 for a 32-user version, Axcess requires SCO UNIX 3.2.1, Open Desktop 1.0, and a LAN adapter card. **Atlantix, 4800 N. Federal Hwy., Ste. 301-B, Boca Raton, FL 33431; 800-262-6526 or 407-362-9700.**

Circle No. 317 On Inquiry Card

What Does This Symbolize To You?

Incorporating its Genera 8.0 object-oriented development system, Symbolics' UX1200S coprocessor lets you run Lisp-based applications on the SPARCstation. You can configure up to five UX1200S processors in one host, so that it can act as a server for the development of AI, CAD/CAE, manufacturing, and other engineering applications. The UX1200S features an extended instruction set supporting object-oriented programming, automatic storage management, and the memory management necessary for large virtual memories used in the development of faster software. The coprocessor, including 20 megabytes of ECC (error control and connection) memory, costs $23,500; an additional 20 megabytes of add-on memory costs $6,000. **Symbolics, 8 New England Executive Park, Burlington, MA 01803; 617-221-1021.**

Circle No. 318 On Inquiry Card

Logistically Speaking

The logistics of process manufacturing, from traffic planning to distribution, are taken up in Uniteq's DLM (distribution and logistics management) software. Targeted toward such process manufacturing concerns as packaged goods, chemicals, food, textiles, pharmaceuticals, and paper, the DLM software charts traffic control and auditing, distribution requirements planning, and warehouse management. It's set up in modules so that it can either be integrated with the hardware and software you already have, or purchased in any combination, from single-function software components to multiplant enterprise solutions.

The DLM software works with Uniteq's CAS (common application

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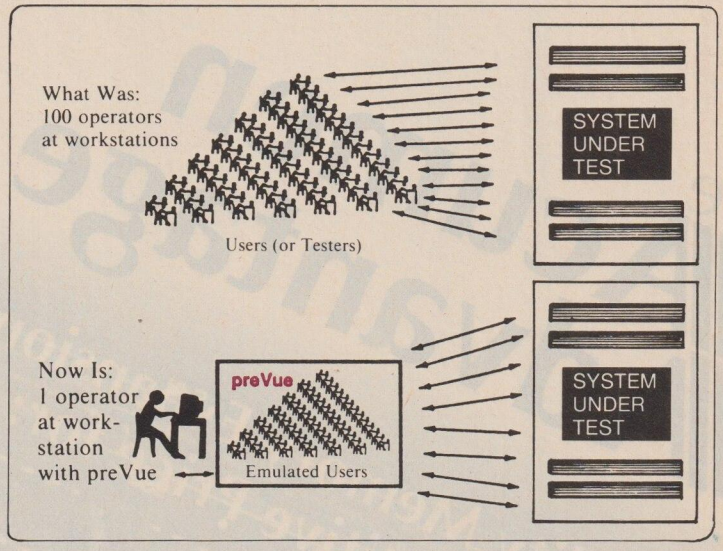

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preVue™ provides the capability to determine total system performance before the system is actually released to the user community. Whether buying or selling, the preVue product line provides you with comprehensive, accurate, reliable, and user friendly RTE tools to obtain performance and quality assurance data.

- **preVue**: complete user emulation facility for RS-232 and Network Users.
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When you need to stress test a computer, use the tools that set the reference standard for RTE Benchmarking: preVue. You can't afford to settle for anything less.

Performance Awareness

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set), a core group of seven basic functions: inventory, purchasing, sales order management, lot tracking, packaging, forecasting, and costing. Running on UNIX-based platforms from Hewlett-Packard, IBM, and Unisys, Uniteq's software starts at $14,000. **Uniteq, 2953 Bunker Hill Lane, Ste. 204, Santa Clara, CA 95054; 408-980-5500.**

Circle No. 319 On Inquiry Card

Hardware & Software Support

To **Acucobol-85**: Programmed Intelligence's Intelligent Query report writer (404-446-8880).

To **Alliant FX 2800**: MARC finite element analysis software (415-326-7511).

To **Apollo DN2500 and DN10000**: Frame Technology's FrameMaker 2.1-X (408-433-3311).

To **Apple A/UX 2.0**: Bowers Development's AppMaker application generator (508-369-8175); Interactive Software Engineering's Eiffel object-oriented language (081-780-2324).

To **Ashton-Tate dBASE IV**: Buzzwords International's dAnalyst development tool (314-334-6317).

To **Cetia workstations**: Frame Technology's FrameMaker 2.1-X (408-433-3311); Oracle's DBMS (415-506-7000); Telesoft's Ada (619-457-2700).

To **Concurrent 5000 and 6000**: Entropic's ESPS signal processing and graphics software (202-547-1420).

To **DECstation**: BBN/Slate multimedia document communication software (617-873-3196); Frame Technology's FrameMaker 2.1-X (408-433-3311); Systems Union's SunSystems accounting software (212-753-7777).

To **DEC Ultrix**: Syntax's LAN Manager for UNIX network operating system (206-833-2525);

To **Eicon Technology**: PostScript support for its EiconScript language printer controller cards (514-631-2592).

To **Graphic Strategies**: X Windows, SunOS, and PDOS 4.0 real-time OS support for its VGME-34010 graphics controller (408-745-6500).

To **Hewlett-Packard Softbench**: Acucobol-85 compiler (619-689-7220); Nu-Thena Systems' Foresight rapid prototyping software (408-752-8100).

To **Hewlett-Packard 9000**: Frame Technology's FrameMaker 2.1-X (408-433-3311).

To **IBM RS/6000**: Accelr8 Technology's VMS-to-UNIX integration software (303-863-8088); a/Soft's nu/TPU text editor (603-898-6690); DSP's Dadisp engineering spreadsheet (617-577-1133); Frame Technology's FrameMaker 2.1-X (408-433-3311); IMSL Libraries mathematical and statistical software (713-782-6060); Meta Software's Hspice analog simulator (408-371-5100); Six Sigma Case's Canonizer database design tool (800-827-4462); Syntax's LAN Manager for UNIX network operating system (206-833-2525); Ten X Technology's Opti-Win WORM subsystems and OptiXchange multifunction optical storage subsystem (512-922-9050).

To **Intel iX86 PCs**: Sybase's RDBMS (415-596-3500).

To **Intel i860**: Lynx Real-Time

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You say you want
486 technology.

You say you want
expandability.

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Systems' LynxOS 1.2 (408-354-7770).

To **Intel i960**: Wind River Systems' VxWorks real-time operating system (415-748-4100).

To **MIPS R3000 and R6000**: Lynx Real-Time Systems' LynxOS 1.2 (408-354-7770).

To **NCR System 3000**: Acucobol-85 Cobol compiler (619-689-7220); Information Builders' Focus 4GL (212-736-4433); Sinc's FlexGen 2.0 Cobol applications generator (800-543-4035).

To **NCR Tower**: Syntax's LAN Manager for UNIX network operating system (206-833-2525).

To **Neuron Data Nexpert Object**: Stone & Webster's Montrex real-time process tool for monitoring and diagnostic applications (415-321-4488).

To **SCO Open Desktop**: Buzzwords International's Professional Edit text editor (314-334-6317); Frame Technology's FrameMaker 2.1-X (408-433-3311).

To **SCO UNIX**: Empress RDBMS 4.3 (301-220-1919); Syntax's LAN Manager for UNIX network operating system (206-833-2525).

To **Sequent**: Syntax's LAN Manager for UNIX network operating system (206-833-2525).

To **Silicon Graphics Iris**: Adobe Display PostScript (415-960-1980).

To SPARCstations: Nu-Thena Systems' Foresight rapid prototyping software (408-752-8100).

To **Sun**: Frame Technology's FrameMaker 2.1-X (408-433-3311); Hewlett-Packard's OpenView network management software (800-752-0900).

To **Tadpole Technology**: Software Components' pSOS+ and Ready Systems' VRTX velocity real-time software (512-338-4221).

To **X**: Performance Awareness' PreVue-X remote terminal emulator (919-870-8800).

Hardware Upgrades

Cisco Systems adds frame relay support for its multiprotocol routers and bridges (415-326-1941).

CMC adds its TCP/IP for UNIX 2.6.1 to its intelligent VMEbus Ethernet adapter (805-968-4262).

NCD adds on-board twisted-pair Ethernet connections to its X terminals (415-694-0650).

Sequoia Systems adds several communications capabilities to its OLTP minicomputers, including support for AT&T's Datakit telecommunications interface, ISDN, IBM mainframe connectivity, a variety of OSI (Open System Interconnection) services, OSF's (Open Software Foundation's) distributed computing environment, and LAN connectivity (508-480-0800).

Spider Systems adds a new Ethernet interface board, more user-defined statistics, enhanced automatic alarms, address modification, and additional protocol decoding to its SpiderMonitor and SpiderAnalyzer network monitors (617-270-3510).

Sun SPARCservers incorporate Sun QuickCheck software to speed up the file-checking process after a system reboot (415-960-1300).

Visual Technology adds DialGuard's Smart Card security system for monitoring host access from X Display Stations (508-836-4400).

Wellfleet Communications adds OSPFIGP (open shortest path first interior gateway protocol) support and frame relay interface support to its multiprotocol routers and bridges (617-275-2400).

Software Upgrades

Advanced Computer Communications enhances its ACS 4800 network management system with an application programmer interface (API) (to incorporate other protocols), a management information base (MIB) utilities tool (to add private MIB extensions), and a relational database (805-963-9431).

Amdahl enhances the connectivity and security capabilities of its UTS 2.1 UNIX software (408-746-6000).

BBN Software adds color geometric and business graphics, and PostScript support to its BBN/Slate multimedia document communication software (617-873-3196).

Binary Research adds a new windowing manager and scrollable data-record windows that let you highlight the selections you want to retrieve in its Apogee 5.1 4GL (215-233-3200).

Boston Business Computing enhances its VCL 3.0 DEC command language for UNIX with encryption capabilities, device and memory displays, symbol bit overlay (to define symbols containing non-printing characters), and new lexical functions (508-470-0444).

Carberry Technology adds two-way conversion between Interleaf ASCII format and CGM format, as well as preview capabilities to its CADleaf 2.0 CAD publishing software (508-970-5358).

Computervision adds solids editing and modeling tools to its CADDS 4X 6.0 mechanical design software (617-275-1800).

Digital Research incorporates telnet and FTP support and support for transport across multiple networks into the FlexNet 2.0 network extension to its FlexOS real-time operating system (408-649-3896).

Emulex adds Serial Line over Internet Protocol (SLIP), Simple Network Management Protocol (SNMP), and enhanced BSD rlogin connection capabilities to its terminal server software release 2.1 (714-662-5600).

Graphic Software Systems incorporates support for X11R4 and 8514/A displays in its PC-Xview 2.1 X terminal emulator (503-641-2200).

Insignia Solutions extends the capability of its SoftPC EGA/AT option module, so that A/UX 2.0 users can run DOS programs on the Macintosh (800-848-7677).

Isocom enhances its EZ-Editor 2.0 text editor with keymapping capabilities (to mirror `vi`) and more help facilities, as well as the ability to create customized editing queue files, and to delineate editing limit markers, among other features (214-490-8288).

Legato Systems offers a 2.5-gigabyte 8-mm tape drive for its entry-level NetWorker backup-and-recover software (415-329-7880).

Lynx Real-Time Systems improves System V interprocess communications facilities, adds demand-paged virtual memory, and supports Ada, Posix 1003.4, X, Motif, NFS, and TCP/IP in its LynxOS 1.2 real-time operating system (408-354-7770).

Melillo Consulting adds the capability for locale-specific and bit-mapped fonts, such as Asian character sets, to its Open Look 2.0+ GUI for HP 9000 workstations (201-873-0075).

Optical Software Solutions upgrades OSS Wormware, for data interchange between DOS, NFS, and Netware, to support both write-once and rewriteable optical media (415-825-3441).

Sinc adds an SQL interface, 4GL language set, Cobol compiler compatibility, expanded print and display capabilities, and a menu-driven query interface to its FlexGen 2.0 applications generator (800-543-4035).

WordPerfect adds compatibility for Tundra Software's UNIX/DOS bridge Rapport in its System V/386 release (416-681-3322).

Compilers & Development Tools

To **Ada**: Alsys' development environment for IBM 370/AIX (617-270-0030); Telesoft's development tools for the

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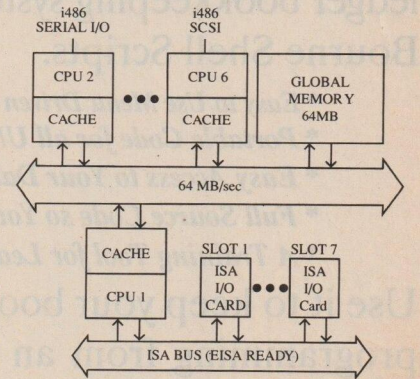

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Cetia workstation (619-457-2700); Verdix's development system for the IBM RS/6000 (703-378-7600).

To **Cobol**: Ryan McFarland's RM/Cobol-85 5.0 adds pop-up windows, X/Open compatibility features, and use of synchronized write operations for improved data integrity, among other features (512-343-1010).

To **C++**: Hewlett-Packard offers HP C++ 2.1 for HP-UX, HP C++ Developer for Domain, and Domain/C++ 2.1 (800-752-0900).

To **Motorola 68EC030 processors**: Applied Microsystems EL 3200 development and emulation support (206-882-2000).

To **Motorola 68331 microcontrollers**: Hewlett-Packard's emulation architecture includes host-independent interface, emulation-bus analyzer, and tools to gauge software performance and timing (800-752-0900).

To **Motorola 88100 processors**: Arium's ML4400 logic analyzer, encompassing a target interface adapter and a disassembler (714-978-9531).

To **SDTools**: AT&T's MetaTool Specification-Driven Tool Builder (SDTB) helps developers build applications from high-level specifications instead of source code (800-462-8146).

To **Sun Cobol**: Informix's ESQL/Cobol application development tool for embedding SQL statements into Cobol (415-926-6300).

To **yacc**: Bloomsbury Software's ydb symbolic debugger for yacc grammar debugging and parser generation (415-964-3486).

Product Line Extensions

To **Arche Technologies**: symmetric multiprocessing 486 PCs (415-623-8100).

To **Auspex**: the NS 3000 NFS file server supports up to 50 diskless clients (408-492-0900).

To **Cetia**: 68040-based and 88000-based workstations and servers with from three to eight VME slots (33-9421-8475 or 508-458-3100).

To **Computervision**: a CADDS 4X CAE/CAD/CAM workstation based on the Sun SPARCstation IPC (617-275-1800).

To **Dotronix**: M-9000 Megascreen dual-page monitors in 19- and 21-inch sizes, for the Apple Macintosh with 75 dots per inch (1024-by-826) resolution (612-633-1742).

To **MIPS**: the R3000A CMOS microprocessor consumes less power, needs fewer SRAMs to build a cache memory, and offers dynamic endian switching; the latter enables software to run on machines configured in either big endian or little endian byte order without recompiling (408-720-1700).

To **Motorola 68030**: the 68EC030 is a low-cost version of the 68030 for embedded control applications; packaging, die size, and available memory-management functions differ from the 68030, but it is compatible with all 68000 chips (512-891-2839).

To **Wyse Technology**: the multiuser, multiprocessor Series 7000i runs SCO, AT&T, and Interactive UNIX at speeds from 27 to 160 mips (408-473-1200).

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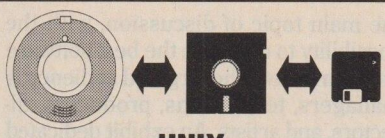

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continued from page 157

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The U.S. federal government is spending an estimated $5.7 billion for UNIX-related systems. We'll tell you who spends the most and which vendors are winning these bids.

Making X Understandable

Oliver Jones, author of *Introduction to the X Window System*, reveals his philosophy on global activism in the "Profile" section.

Keeping Disks Under Control

Disk controllers help manage the transfer of data between the CPU and the disk drive. How do you choose the one that's right for your system? We interview buyers who have tested these products and have advice to help you make the right choice.

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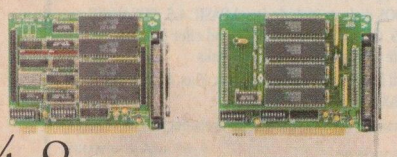

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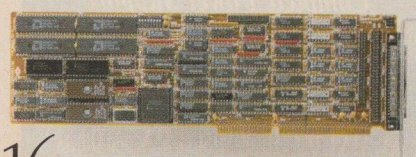

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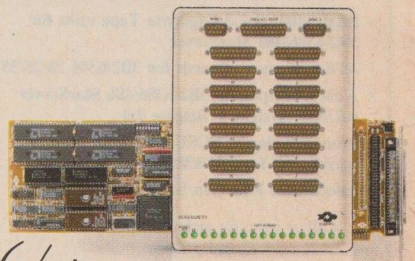

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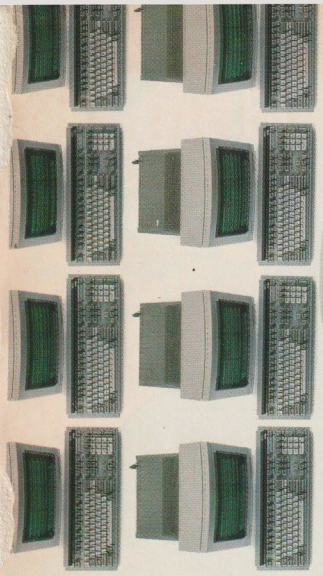

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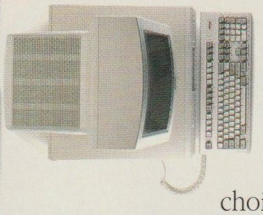
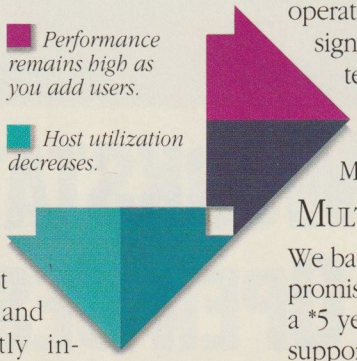
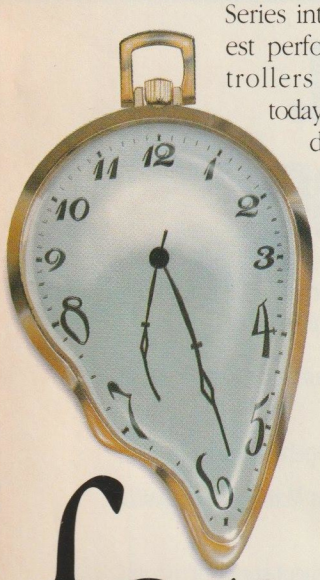


Multiplied Performance

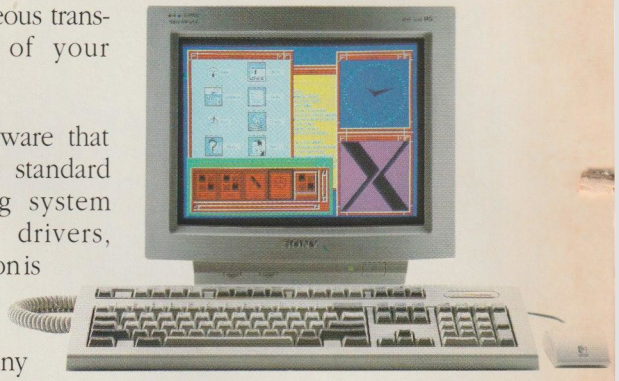
No company offers you more performance than Comtrol. In fact, our new DT *Express* driver transforms our Ultra Series into the highest performing controllers available today. DT *Express* dramatically reduces host utilization and significantly increases throughput by managing all data transmission and data transform functions on the controller. So now as you add users, no one gets caught in a wait state.





MultiVision. For Choices Beyond Words

When graphics enter the equation, MultiVision enters the picture. A fully functional multiuser system for up to 16 users, MultiVision speeds images to the screen at a blistering 100 megabits per second. As a result, you'll experience near instantaneous transmission of your graphics.



With software that enhances standard operating system graphics drivers, MultiVision is compatible with virtually any monitor, keyboard, mouse or VGA controller supported by the operating system. MultiVision can also run applications designed for the "X" environment. But unlike a LAN-based "X" terminal, MultiVision is a multiuser system that transfers data up to 100 times faster. When you compare that performance with the cost of an "X" terminal... MultiVision's advantages really compute.

Multiplied Protection

We back our products with an uncompromising 30-day satisfaction guarantee, a *5 year warranty, complete technical support, and most importantly...a company that's easy to do business with. It all adds up to the best protection plan available. And if you're a VAR, call us about our Reseller Program that provides you with options designed exclusively for your needs.

30/5

*1 yr. MultiVision

See us at
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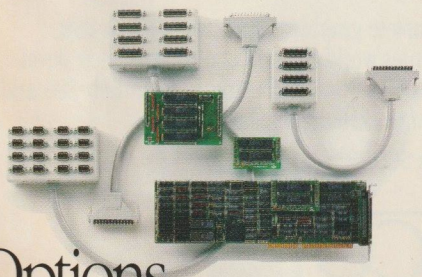
for Multi-Users.



Options

Our products offer serial port and memory options that are field upgradable; compatibility with ISA (AT), MicroChannel and EISA buses; RS232, 422, 485 and Current Loop interfaces and DB 9, DB 25 and RJ 45 connectors.

Graphics

When your needs move beyond text, MultiVision moves into view--a high speed (100 megabits per second) communications controller that offers near instantaneous multiuser graphics like you've never seen before.

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